

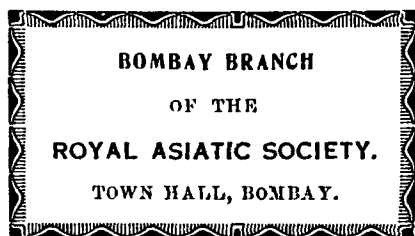
297

American Museum of
Natural History
Guide Leaflets. 57, 58 + 60-61

590.74
Luc/Gris
38555

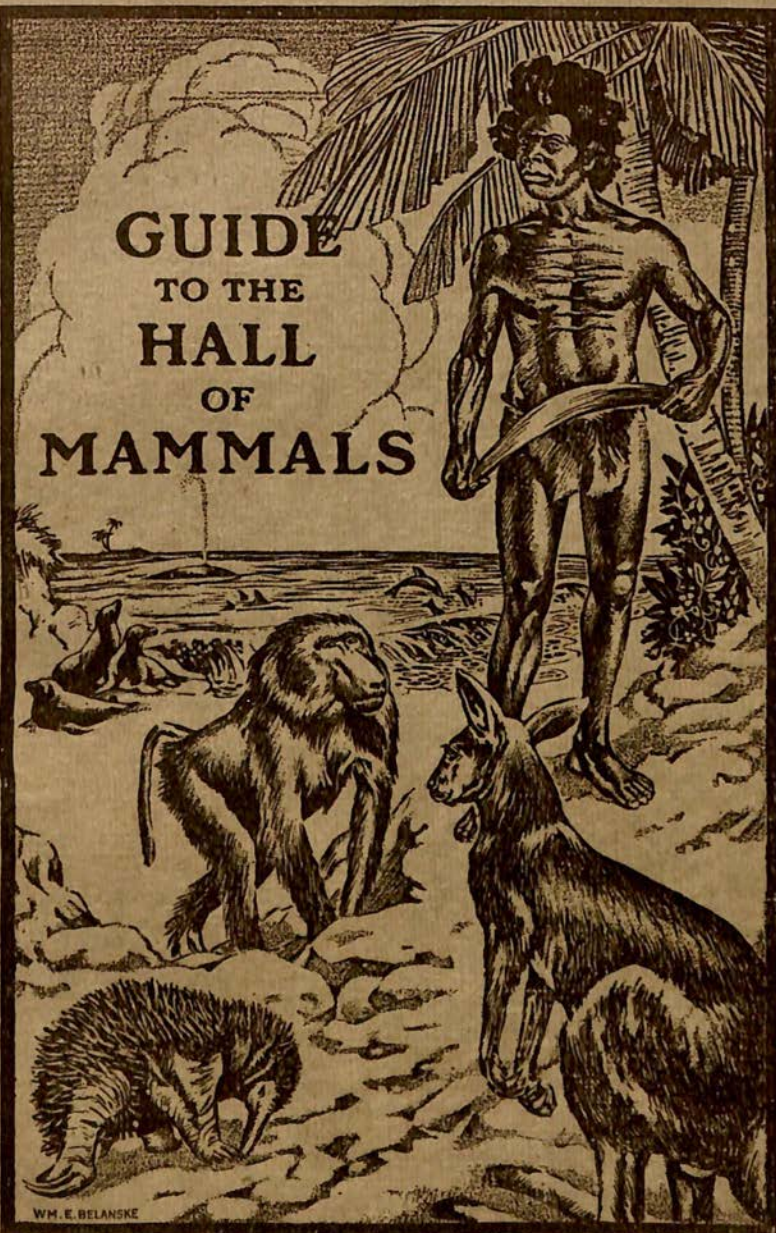


00038555

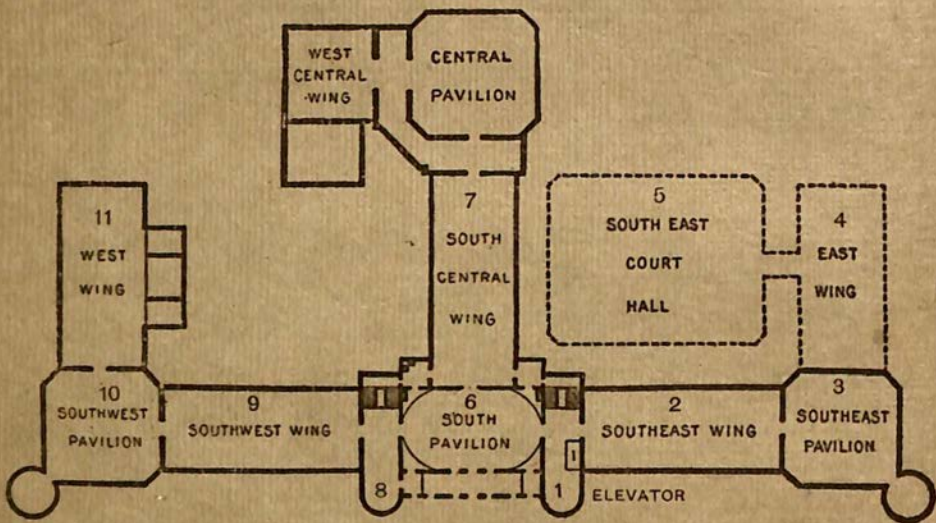


THE AMERICAN MUSEUM

**GUIDE
TO THE
HALL
OF
MAMMALS**



OF NATURAL HISTORY



THE HALL OF MAMMALS

is on the **THIRD FLOOR**, **SOUTHEAST WING**, just to the right of the elevator. It is number 2 on the floor plan shown above

GUIDE
TO THE
HALL OF MAMMALS

BY
FREDERIC A. LUCAS

38555



The American Museum of Natural History
Guide Leaflet No. 57
New York, October, 1923

590.7j
L1 1 1j
38555



The **Guide Leaflets** describe some exhibit, or series or exhibits, of special interest or importance, treat of some branch of museum work, or, as in the present case, may deal with the contents of an entire Hall. A list of the "popular publications" of the museum may be obtained from the librarian.

GUIDE TO THE HALL OF MAMMALS

By Frederic A. Lucas

This leaflet was written in the hope that it might prove useful to classes and visitors in connection with the exhibits in the Hall of Mammals. Its object is to point out the purpose of the exhibits, to tell why the specimens are shown and what they are intended to illustrate. And for the very reason that it is not intended as a text book, but for use with the collections it has been left largely an outline to be filled by those using it.

It deals with Mammals, a term frequently confused with Animals. Strictly speaking, all living creatures are animals, but to many people, possibly the majority, animal means a mammal in distinction to birds and other creatures.

The collection was begun with the view that it might be helpful to students and scholars by providing them with a handbook in which the reading matter should be furnished by the labels and the illustrations by the objects themselves. It was also hoped that it might prove of interest to visitors and that without special effort they might get an idea of what a mammal is.

Like a book it is to be read from left to right, beginning with the Characters of Mammals and the Family Tree of Mammals at the left of the entrance, and ending with Man, who is a species of Mammal and considered by himself to be the head of his class.

The story of man is told elsewhere, his evolution and early history in the Hall of Age of Man and Hall of Archæology, the characters and customs of living races in various halls of the Department of Anthropology.

The object of the exhibits is to show the distinguishing features, or *characters of mammals*, the points wherein they agree with one another and differ from other animals; their main groups or *Orders*, and the subdivisions of their orders or *Families*; as well as the variations in the skeleton, *Modifications of structure*, whereby they are adapted to different modes of life, the whales for dwelling entirely in the sea, the seals for living in the sea or on land, the horse for land only and the sloth for the trees.

As the exhibits give a brief, but comprehensive illustration or synopsis of the points noted above, they form collectively the *Synoptic Series of Mammals*.¹

The exhibits are divided into, or may be considered in two sections, the Systematic Series, that deals with the larger divisions of Mammals, Orders and Families, and a Special Series that deals with special features of the Class and includes examples of some of its rarer or more interesting members.

MAMMALS

Their Characters, Divisions and Modifications

Mammals are warm-blooded, backboned animals that with a few rare exceptions are born alive and nourished for a time on milk.

They may be large or small, naked, covered with hair or scales, have teeth or be toothless; live on land or in the water, swim, walk, fly or burrow in the ground, but they agree in the above particulars and are all placed in the Class Mammalia. They belong, with Birds, Reptiles, Amphibians and Fishes in one of the large groups or Phyla, of the Animal Kingdom termed Vertebrata or back-boned animals, because they all have a vertebral column or back bone. (See Family Tree of Mammals).

¹Note: The writer and curator is well aware that this is not an attractive title, but he has been unable to think of any other that combines brevity with accuracy and will be glad to receive suggestions in regard to it.

CHARACTERS OF MAMMALS

(First Wall Case on Left)

A technical exhibit for advanced students: it deals at length with the distinctive characters of mammals and compares, or contrasts them with the corresponding characters of reptiles, from which mammals are considered to have been derived. It is an answer to the question, What is a mammal?

FAMILY TREE OF MAMMALS

(First Pier Case on Left)

Showing the relation of mammals to other groups of animals.

Note how life began with animals of simple structure from which as time went on more complex or higher forms were evolved. The mammals appeared late in the history of the earth and stand at the top of the "Tree."

GENERAL OR SYSTEMATIC SERIES

Mammals arranged according to a given plan or system—in this case their structure. An illustration of the methods employed in classification will be found in a pier case on the North Side showing the divisions of the seals—*Pinnipedia*, based on resemblances or differences in their skulls and especially in their teeth. The mounted specimens and skeletons show the outward form and internal structure of the groups, and the maps of distribution show where they occur. The accompanying labels give information as to their general character, appearance in time and peculiarities of structure.

THE ORDERS OF MAMMALS

Following is a list of the Orders of Mammals with brief explanatory notes in regard to them. The names may appear formidable because they are unfamiliar but they are the names in general use in text-books, in many cases there are no "common" names and it is hoped that a little observation of the collections and the notes in this leaflet may cause the names used to appear a little less fearsome.

MONOTREMATA, Egg-laying Mammals, Monotremes. Include the Platypus and Echidna; termed primitive because they resemble in structure the reptiles from which mammals are believed to have been derived. They differ from all other mammals in that the young are hatched from eggs, though nourished on milk. They are placed in a group or sub class, termed *Prototheria*, the first mammals.



PLATYPUS

Ornithorhynchus paradoxus



ECHIDNA

Echidna aculeata

Information in regard to Classification, Scientific Names, and related points may be found in A First Chapter in Natural History.

MARSUPIALIA, Pouched Mammals, Opossums, Kangaroos and related animals.

The young are born at an early stage and during the first part of their life carried in a pouch. The greater number are found only in Australia. They vary greatly in form and habits and we have marsupials that are flesh eaters, grass eaters and rodents; they jump, climb, run, and a few sail like our flying squirrel. The Marsupials are given a sub class, *Metatheria*, intermediate mammals, as ranking between the



HEDGEHOG

Erinaceus europæus

An insectivore that suggests a little Porcupine

egg-laying mammals and those in which the young are well-developed when born.

The following *Orders* from Insectivores to Primates contain the vast majority of existing mammals, including those with which we are most familiar; they form a large assemblage known as *Eutheria*, the right or perfect mammals.

INSECTIVORA, Insect Eaters; animals of small size, many of them, like the mole, adapted for an underground life where they feed on worms and insect larvæ.

CHIROPTERA, Bats; the only mammals that really fly, their immensely long fingers, supporting like the ribs of an umbrella, a membrane that forms a wing. Their distribution depends mainly on temperature; when the cold puts an end to the insects on which they feed, the bats hibernate, go into winter quarters and sleep until spring. The fruit-eating bats, the largest members of the order, are found only in warm countries where they can obtain food throughout the year.

CARNIVORA or **FERÆ**, The flesh eaters or Beasts of Prey. Familiar examples are the dog and cat. The cat is "a carnivorous, fissiped, digitigrade mammal of the family *Felidæ*;" that is, it is a flesh-eating animal, whose toes are separate, that walks on the tips of its toes, nurses its young, and is a member of the Cat family.

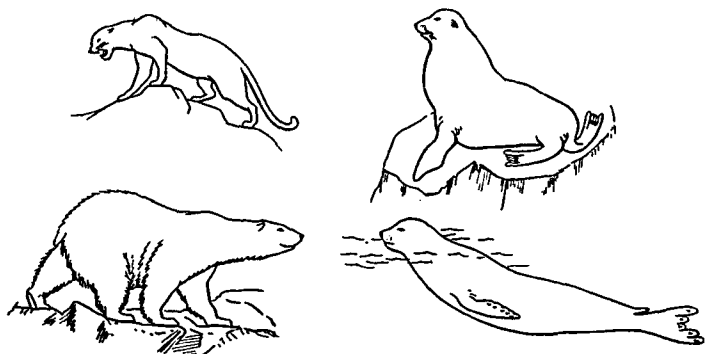
The Carnivores are divided into two great groups, the Fissipedia, whose fingers are free and the Pinnipedia whose fingers are united to form a paddle. The first group includes the majority of the flesh eaters—the Lions, Wolves, Bears and Weasels, the second the Seals and Walruses.

AN OUTLINE OF THE CLASSIFICATION OF THE BEASTS OF PREY—ORDER FERÆ

Fissipedia	Pinnipedia
Feet for Walking	Feet for Swimming
Cats	Walruses
Weasels	Eared Seals
Dogs	Earless Seals
Bears, etc.	

Also the cat is digitigrade—walks on its toes—and the bear is plantigrade—walks flat-footed—and the seal is pinnigrade—swims with its feet.

“Classification” is merely the orderly arrangement of animals or other objects, placing those most closely related to one another in a group by themselves and arranging the groups thus formed with reference to their degree of relationship.



TYPES OF CARNIVORES

Panther
Polar Bear

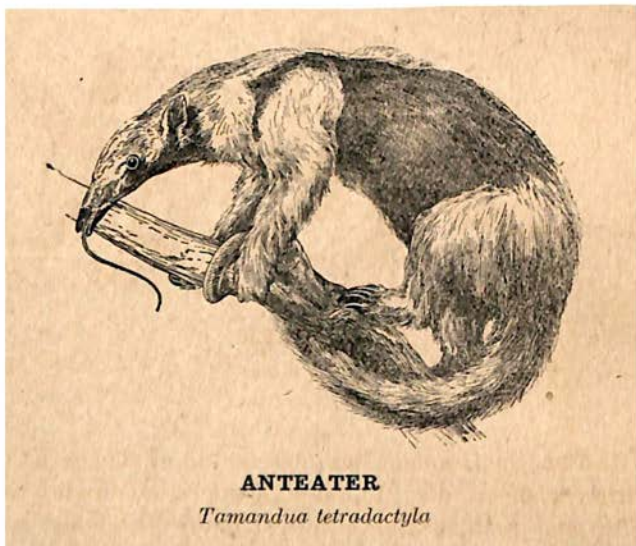
Fur Seal
Harbor Seal

RODENTIA or **GLIRES**, Gnawing Animals, including rats, mice and rabbits; mostly small animals, the giant of the order being the South American Capybara. This group contains more species and individuals than any other order and owing to their small size, adaptability and rapidity with which they breed, its members are found over the greater part of the earth. The most evident character of the order is the structure of the front teeth, incisors, which are made on the principle of some chisels, a thin cutting edge of hard enamel in front, backed with soft dentine; this wears away faster than enamel, automatically keeping the teeth sharp. The cutting teeth grow continuously and rodents *must* gnaw to keep them worn down.

BRUTA or **EDENTATA**, Sloths, Armadillos and their relations.

A mixed assemblage of mammals varying greatly in outward appearance. They are "low" in their brain characters and intelligence, "low" in the simple structure of their teeth and in some features of the skeleton.

The term Edentata—toothless—is literally true in regard to the Ant Eaters, and all members of the group agree in lacking front teeth.



ANTEATER

Tamandua tetradactyla

PHOLIDOTA, Scaly Anteaters, Pangolins, Manids—one of the cases where the so-called common name conveys no idea to the average person. The members of this order are distinguished by being clad in overlapping horny scales which offer a pretty good protection when the animal coils up with the tail outside. They are confined to Tropical Africa south of the Sahara, and southern Asia. One species is noteworthy as having the longest tail of any Mammal, fifty-two vertebrae, one for every week in the year.

EFFODIENTIA, the Aard varks, so called in allusion to their burrowing habits, though the order has also been termed *Tubulidentata* in reference to the structure of the teeth which are composed of little tubes placed on end.

This order includes only two species of animals found in the warmer parts of Africa and formerly placed with the Edentates.



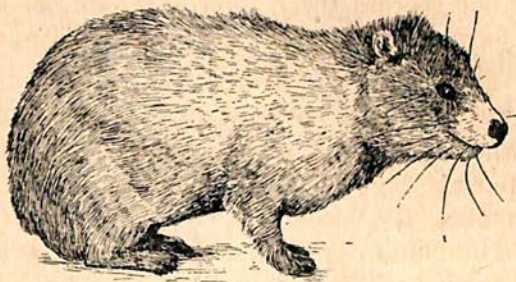
AARD VARK

Orycteropus ater

UNGULATA, the Hoofed Mammals, including such well known forms as sheep, deer, antelope, camels, cattle and horses. The vast majority of large quadrupeds belong in this order whose members are widely distributed over the earth, save Australasia, and were abundant until killed off by man. They are most numerous in Africa, least numerous in South America and there are none in Australia.

HYRACOIDEA, Hyraxes or Dassies, neither of which "common" names conveys any meaning, being a good illustration of the fact that a so-called "common" name may be just as meaningless to the majority of people as a scientific name. An order including a few species of small mammals looking something like rabbits, but not at all like them in any part of their structure and really related to the Rhinoceroses. The species found in Syria is the coney

mentioned in the Bible, "The conies are but a feeble folk, yet make they their homes in the rocks."



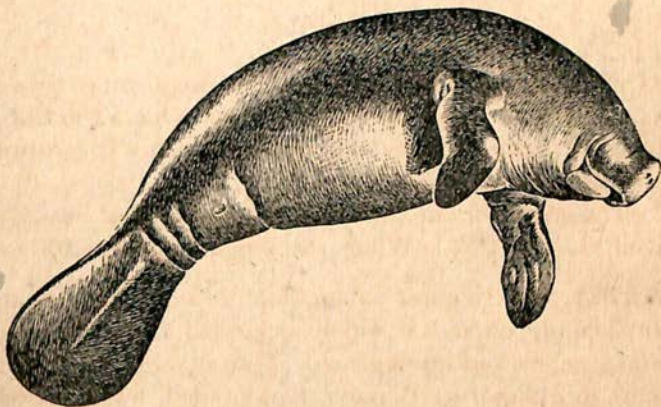
HYRAX OR DASSIE

Hyrax capensis

PROBOSCIDEA, Elephants, present and past.

"Beast that hath between its eyes a serpent for an arm."

The largest of land mammals distinguished from other mammals by many well defined characters, size not being a character.



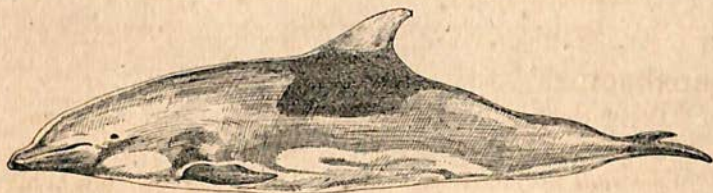
FLORIDA MANATEE

Trichechus latirostris

A member of the Order Sirenia noted on the opposite page

SIRENIA, the "Sea Cows," Manatees and Dugongs. An ancient order including but few species and these widely separated. Mostly confined to tropical, or warm waters, though one species, the Rytina or Arctic Sea Cow, the largest member of the group, was found in the north where it was exterminated by man.

CETACEA, Whales and Porpoises. Mammals adapted for living wholly in the water, often mistakenly thought to be fishes, though they breathe by lungs and not by gills and must come to the surface for air. Their fore limbs are modified into flippers, the hind limbs present as mere vestiges concealed within the body and the tail present in the shape of flukes.



COMMON DOLPHIN

Delphinus delphis

A rough and ready means of distinguishing between cetaceans and fishes is that the former have the tail, or flukes, crosswise to the body while in fishes it is always vertical, up and down.

The order contains the largest animals that have ever lived, the great Blue Whale reaching a length of 103 feet.

PRIMATES, the "highest" mammals, Man, Apes, Monkeys and Lemurs, these last widely separated from the others in characters and intelligence. Man is sometimes placed apart in a Suborder Bimana, two-handed, while his relatives are termed Quadrumana because in most of the species the big toe is opposable to the others so that the foot, like the hand, is fitted for grasping.

SPECIAL SERIES

Illustrations of the relation of internal structure to form and habits; modifications of the teeth; change of color with the season.

RELATION OF ANIMALS TO THEIR ENVIRONMENT

On the left (North) Relation of Animals to their surroundings or *Environment*. Mammals, and other animals, that dwell in deserts are pale and harmonize in color with the sand, thus illustrating protective coloration. The birds, insects and plants offer further instances of adaption; in the case of plants the leaves are reduced in size and number to lessen evaporation.

MODIFICATIONS OF THE SKELETON

The skeleton is the best, and most enduring evidence we have, of any animal's place in nature and its relationships with other animals: it is also the solution of a problem in mechanics, that of carrying a given weight and of adaptation to some particular mode of life. So the skeleton not only indicates the group of animals to which its owner belongs, but also tells of his mode of life, for it varies, or is modified, according as a creature dwells on land, lives underground, or in the water, walks, swims or flies; feeds on grass, catches insects, or preys upon its fellows.

TEETH

Their structure, location, method of implantation, growth, mode of replacement and modifications, with special reference to the teeth of mammals: Case on south or right side of hall.

ALBINOS AND MELANOS

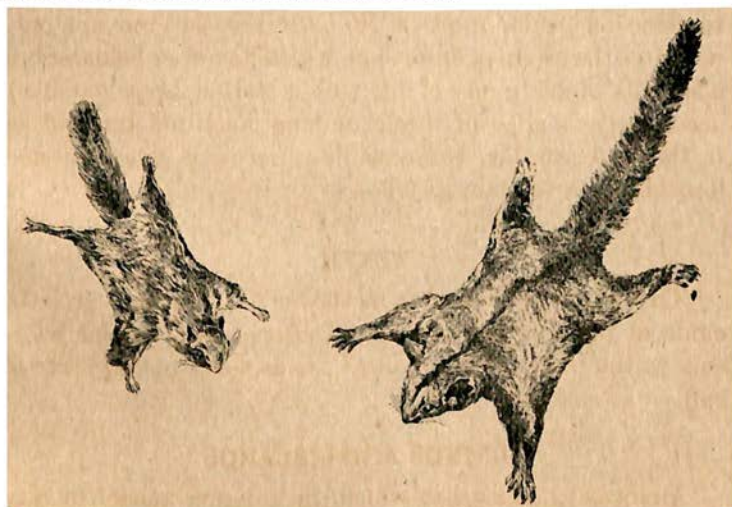
Albinos are animals in which the coloring matter or pigment of the hair or other parts of the body is lacking. They may occur in any group of mammals.

Melanos are animals in which there is an excess of coloring matter. They occur more often than albinos and are particularly numerous in some species or in some localities. In the Grey and Fox Squirrels melanos occur so often as to form a distinct color phase, and black Leopards are common in some localities in southern India and the Malay Peninsula. Baghera of the "Jungle Stories" was a Black Leopard.

ANIMALS THAT LOOK ALIKE BUT ARE DIFFERENT

These specimens illustrate the point that because two animals look alike they are not necessarily related, differences in the skeleton (*Structural Differences*) being much more important than mere resemblance, and furnishing the characters on which classification, or the grouping of animals according to their relationships is based.

The Flying Squirrel and little Acrobat both sail from tree to tree, but one is a rodent and one is a marsupial; the Squirrel and Squirrel Shrew look alike and have the same habits, but one is a rodent and one an insectivore.



FLYING SQUIRREL. FLYING PHALANGER

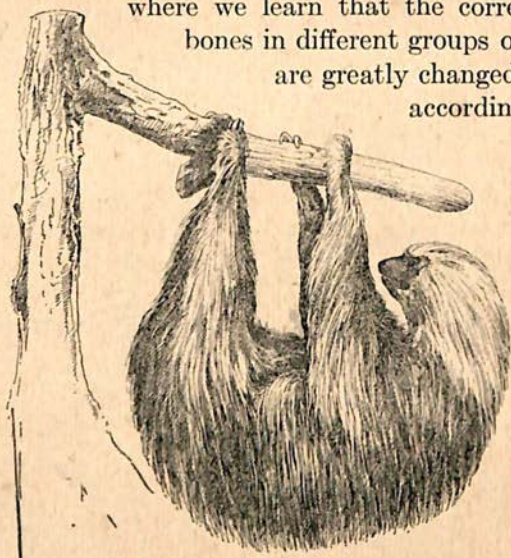
The Echidna, the Hedgehog and the Porcupine all have spines but belong to widely separated orders of Mammals.

The Tasmanian Wolf and the Coyote are much like one another in form and habits, both being flesh eaters, but one is a marsupial and the other a true carnivore.

RELATION BETWEEN FORM AND HABITS

According to their mode of life, the limbs of mammals are modified to form fingers, feet, paddles or wings. The underlying changes are shown in the *Modifications for Locomotion*

where we learn that the corresponding bones in different groups of animals are greatly changed in shape according to their function.

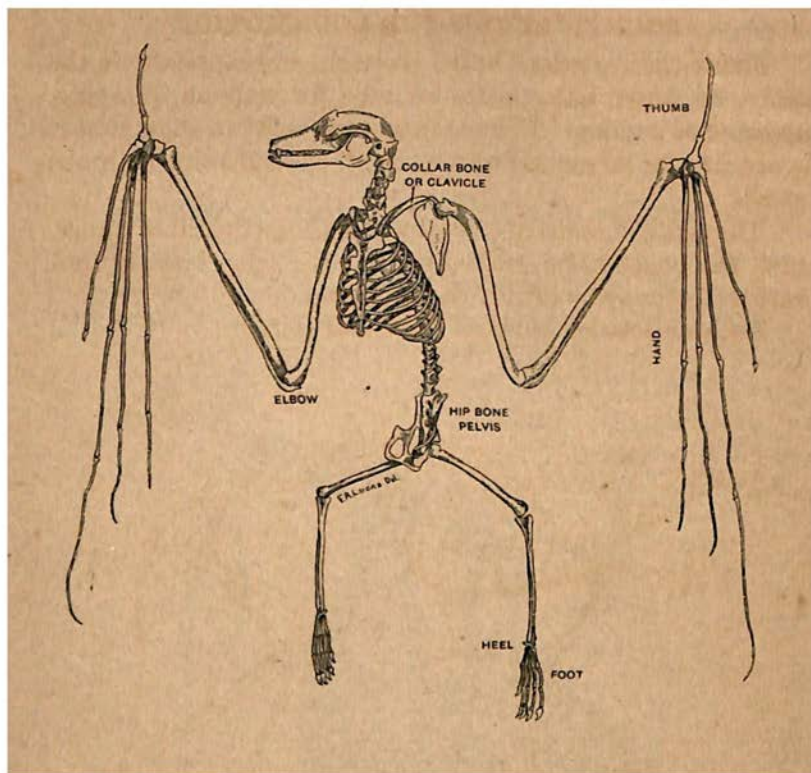


TWO-TOED SLOTH

Cholopus didactylus whose feet are hooks.
The sloth hangs below the branches.

COLOR CHANGE IN THE VARYING HARE

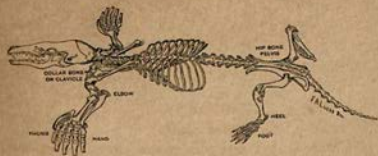
In northern regions many mammals and some birds change their coats with the season, becoming white in winter, a familiar example being the Ermine and Weasel. It is a change of hair and not in the hair, the gray coat being shed and the white one put on early in winter and the process reversed in spring.



FRUIT BAT

Pteropus species

As in other bats the fore legs are modified, or changed, for flight, all the bones, but especially the fingers, being greatly lengthened to form supports for the membrane that serves as a wing. The fruit bats fly with rather slow wing beats and the outer part of the wing is proportionately larger and more rounded than in their smaller, more active relatives. The hind feet are little used, serving mainly as hooks by which the bat hangs itself up—head downwards—to sleep.



MOLE

Scalops aquaticus

Modifications of the skeleton for an underground life are most evident in the fore limbs which perform the work of digging, being for this purpose short and stout, the hands large, and turned on edge. (In the figure the hand is turned down to show the bones).

The foot is also strengthened by the addition of a bone running along the edge of the foot, shown in the picture. This bone is not found in other mammals.

The skeleton of the mole illustrates the fact that a bone of little importance in one group of animals may be of great value in another.

In the cat and the seal, in which there is no particular strain on the fore feet and great freedom of movement is needed, the clavicle or collar bone is very small, or absent: it is also absent in the porpoise in which the fore limb is scarcely used.

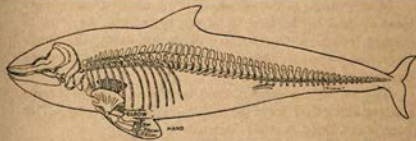
In the bat and the mole in which flying or digging bring great strain on the fore limb, the collar bone is very strong to brace the shoulder. This is particularly evident in the mole.



HARBOR SEAL

Phoca vitulina

Like other seals this species passes some time on land, coming out to bask in the sun, but the legs are of little use for locomotion on land. All four limbs are changed into paddles for swimming, though the hair seals swim mainly with their hind feet and the eared seals with their front feet.



HARBOR PORPOISE

Phocaena communis

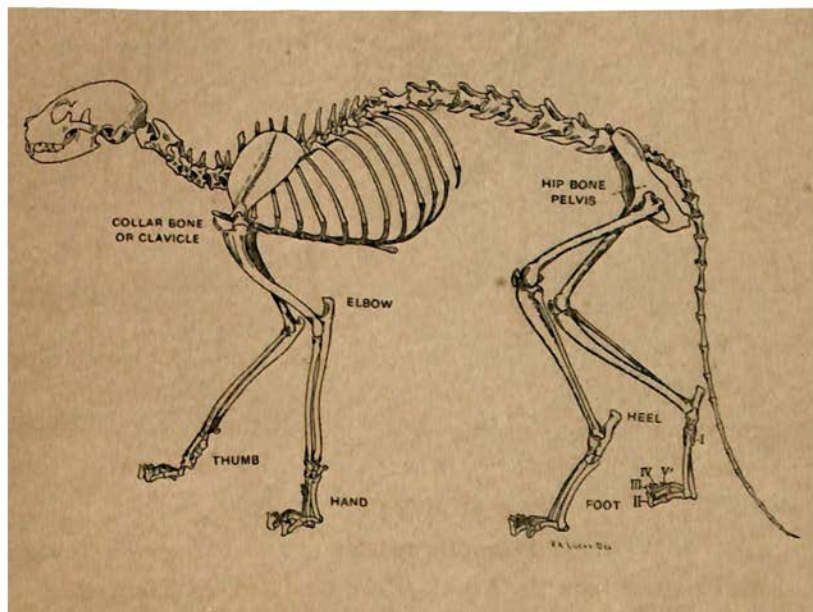
The porpoise is an example of a mammal fitted for living only in the water, and represents the extreme of modification among mammals. The hind limbs have been lost, their only vestiges being two little bones that represent the pelvis, or hip bone: the front limbs have been changed into rigid paddles, fit only for balancing or steering; locomotion is effected by what is really the tip of the tail, which has been developed into flukes for swimming. Note that unlike the tail of fishes the flukes of whales and porpoises contain no bones.

MODIFICATIONS FOR LOCOMOTION

Shows the variations in the skeleton, and especially in the limbs, by which animals are adapted for walking, jumping, flying or swimming. The snake is introduced to show that it is possible for an animal to run, climb or swim with no limbs at all.

The series of limbs in a nearby case shows details of structure, the bones being colored so that the same bone in the various feet may be readily distinguished.

See also Relation between Form and Habits.



THE CAT

Felis domestica

An example of a skeleton slightly modified for free and rapid movements and for jumping—this last point is indicated by the length of the foot bones and the size of the heel and elbow. The skeleton of the cat may serve as a convenient term of comparison with the skeletons of other animals.



FOR THE PEOPLE
FOR EDUCATION
FOR SCIENCE

ph 2

THE AMERICAN MUSEUM OF NATURAL HISTORY

PREPARATION OF BIRDS FOR STUDY



THE COMPLETED SKIN

By JAMES P. CHAPIN

GUIDE LEAFLET No. 58

NOTE

This leaflet is one of a series intended to furnish accurate information in regard to the preparation of specimens of various kinds for Museum purposes.

The following have been issued and may be purchased at the sales booth or from the Librarian; others are in the course of preparation:

The Preparation of Birds for Study

By James P. Chapin. Price 15 cents

How to Collect and Preserve Insects

By Frank E. Lutz. Price 10 cents

**Suggestions to Collectors of Reptiles
and Amphibians**

May be had on application to the Curator, Dept. of Herpetology

THE PREPARATION OF BIRDS FOR STUDY

INSTRUCTIONS FOR THE PROPER PREPARATION
OF BIRD SKINS AND SKELETONS FOR
STUDY AND FUTURE MOUNTING

By
JAMES P. CHAPIN
Associate Curator of Birds



The American Museum of Natural History
New York
1923



00038555

THE PRESERVATION OF BIRDS FOR STUDY

Travelers in foreign parts often fail to realize what valuable service they could render to the museums of America. They are apt to consider the birds of the world so well known as scarcely to need further collecting; whereas, in addition to the numerous species that remain to be discovered, many which have long been known are still unrepresented by a single specimen in any museum of the United States.

To aid in the improvement of our collections, the following instructions are offered for the use of our friends. The scientific value of a skin is greatly enhanced by correct preparation and labeling. To illustrate the successive steps a large number of figures are included, which have been drawn by M. Frazee Belcher.

Collections of birds are composed chiefly of "skins," which resemble in general appearance a dead bird. They exhibit most of the external features of the living bird, the structure and colors of its plumage, as well as the general form of beak, wings, and feet. Bird skins may subsequently be mounted, if desired; but most of them are intended for study rather than for exhibition. Many a skin not fit for mounting is yet of distinct scientific value, provided its history is preserved on the label.

For study of the internal anatomy, skeletons and birds in the flesh preserved in alcohol or weak formalin are also necessary. It is customary to preserve but few examples of a species in this manner, whereas a series of skins is desirable, the external characters being more variable, and more commonly studied by systematic workers. Opportunities for preserving large birds in fluid seldom offer themselves, but their skeletons may be roughly prepared and dried, the final cleaning to be done at home. The skeletons of small birds are so fragile that it is usually better to bring the specimens back whole, preserved in fluid, which permits study of the muscles and viscera as well. The bones can also be cleaned—even though the birds have been kept in formalin—but alcohol is very much better for the purpose.

The preservation of birds as dried mummies, with the aid of carbolic acid or injections of formalin, is to be discouraged. They become very brittle, are difficult to examine, and are subject to the attacks of insects.

The Making of a Birdskin

Instruments

Do not accustom yourself to an unnecessary variety of tools. The fewer they are the more quickly you are sure to work. If nothing else were available, a penknife would suffice to preserve the skin of an ordinary bird. For small and medium-sized birds the following instruments are amply sufficient:

- 1 scalpel, with blade about $1\frac{1}{2}$ inches long;
- 1 pair of sharp-pointed scissors, blade 2 to $2\frac{1}{2}$ inches long—the stronger they are, the longer you can do without a second pair;
- 1 pair of forceps, about 5 inches in length, with long, slender tips;
- 1 thin metal knitting needle;
- 1 pair of cutting pliers, for the wire used in necks; ·
- Ordinary sewing needles (sizes 2 to 8) and cotton thread (Nos. 8, 36, 80), pins, of nicked brass, not of steel;
- 1 medium-sized carborundum stone, for sharpening knives and scalpel;
- 1 rather stiff artist's brush, for washing small spots of blood from plumage, and for moistening skin;
- 1 old nail-brush, for drying and fluffing the plumage;
- Annealed, galvanized iron wire, of sizes 11, 16, 22;
- 1 folding metric rule;
- 1 pair of dividers, for taking measurements.

For larger and tougher birds, one may add to the kit:

- 1 thin-bladed kitchen knife;
- 1 pair of bone-cutters or short, heavy shears;
- 1 longer pair of forceps, about 10 inches over all, with tips not very slender; they will be used for stuffing skins.

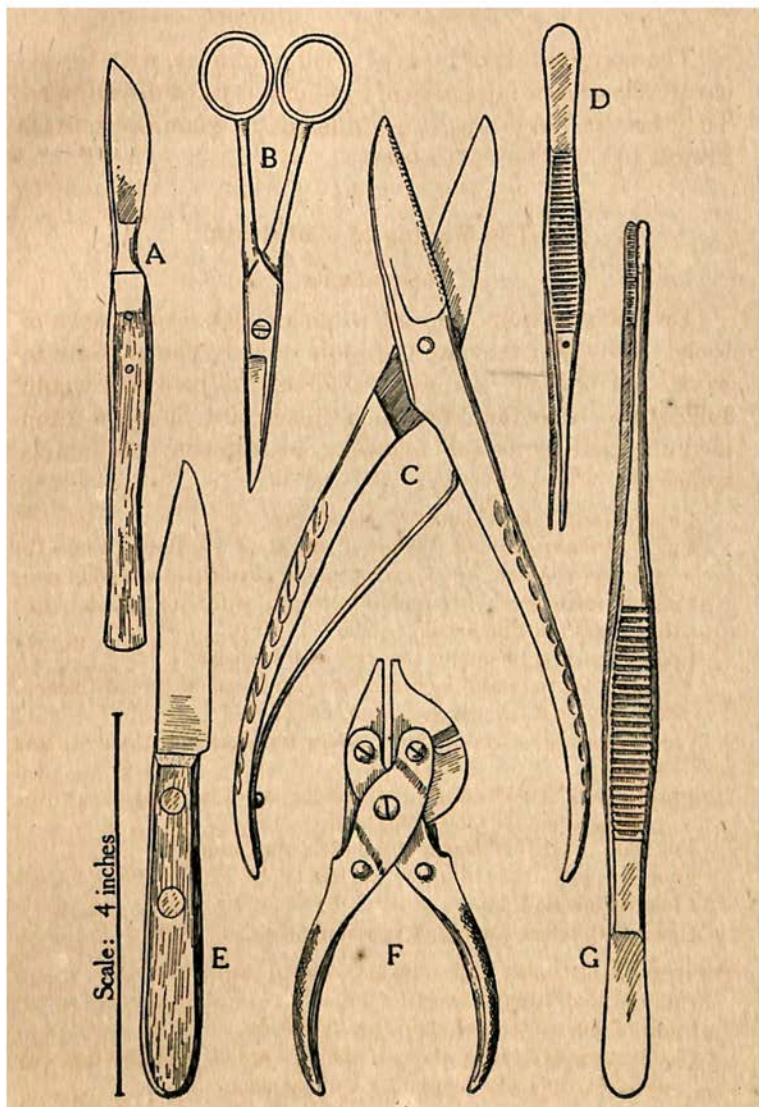


Fig. 1. Principal instruments used for skinning birds: A, scalpel; B, scissors; C, bone shears; D, small forceps; E, kitchen knife; F, cutting pliers; G, long forceps. Their dimensions may be figured from the accompanying scale.

Other Materials¹

Small birdskins are best stuffed with good, long-fibred cotton, not necessarily absorbent; larger ones with tow and "excelsior" wood-shavings, when available. In case of need, green moss may be used after thorough drying, or fine dry grass, or the dry husks of maize—in short, almost any soft, dry vegetable material.

The inside of the skins is to be dusted with powdered white arsenic (=arsenic trioxid), or powdered arsenic and alum (in equal parts by volume). The latter mixture is especially suited for large birds' skins, and for skins of all sizes in a damp climate. The arsenic is used for its permanent effect in preventing insects from eating the skin, rather than for any immediate action as a preservative. It should never be omitted; and used with ordinary care, it offers no danger to the health of the collector. Arsenical soap is more tedious to manipulate, and not necessary.² Put no salt on a bird's skin, save for temporary preservation, as described on page 33.

For preventing the feathers from adhering to the flesh as it is exposed in skinning, for absorbing blood, and for drying parts of the plumage that may have to be washed, fine corn-meal is used. Where this cannot be had, any other starchy meal which does not become sticky when wet will serve, and dry sawdust may also be used. Natives of the tropics frequently prepare coarse flours from rice, millet, or manioc, which are suited to the purpose. Failing these, dry powdered clay, or sand, or wood ashes, may often be employed. Plaster

¹It is not feasible to list all the equipment which a bird collector may find useful. For supplies used in drying and packing birdskins, see pp. 38-40; for preservation of birds in fluid, pp. 41, 42; and for simple soldering outfit, p. 42. Preparing rough skeletons requires no special tools, but arsenical soap solution is useful in safeguarding them, as explained on p. 44

²Arsenical soap is sometimes very useful to paint on beak and feet externally, to prevent attacks by insects. See page 39.

of Paris has been much used by taxidermists, its only fault being that it is almost sure to leave a light powdery bloom on the feathers, particularly if they are of dark color.

When birds are very fat, benzine or carbon tetrachlorid may be used to wash the grease from skin or plumage. Sheets of paper, thin cheesecloth, or mosquito netting are used to wrap large birdskins while drying, instead of the thin layer of cotton which is recommended for small specimens. A collector's tag of convenient size is shown on page 37. Never neglect to take a generous supply of naphthaline, it is the cheapest form of insurance against destruction of skins by insects, and in the tropics is absolutely essential to success.

Care of the Bird before Skinning

By proper handling of the freshly killed bird, a great deal of trouble can be avoided. Pick it up by the bill or feet, and scrape off with a knife-blade any drops of blood which may adhere to the feathers. A small wad of dampened cotton will be useful to wipe off blood-stains, before they have time to dry. Any large shot-hole may be stopped with a bit of cotton, after which corn-meal should be sprinkled among the bases of the neighboring feathers. Open the mouth, and insert a large plug of cotton, pushing it down the throat to prevent the oozing out of blood or other fluids.

In very warm climates, where small insectivorous birds have a way of putrifying and losing feathers on throat and abdomen within a few hours, it is often worth while to carry a hypodermic syringe, with which to inject a preservative into the abdomen. Insert the needle through the vent, pushing it into the body cavity about the intestines. Very weak formalin (1 part to 25 of water) may be used, if there is no objection to the slight hardening of the belly skin; but a saturated solution of alum (*i.e.*, so strong it can dissolve no more alum) does not have this fault, though it retards decay appreciably. Carbolic acid may likewise be employed. Such preservatives

aid greatly in the subsequent determination of the birds' sex, by keeping its organs in far better condition, especially when they are undeveloped. For the throat, a little of the preserving solution (preferably alum) is squirted into the gullet before it is plugged. Alcohol is not to be recommended, for it runs out again too easily on to the plumage.

Next make a cornucopia of stiff paper, drop the bird into it head foremost, seeing that the bill is not turned forward on to the throat; and if the bird is not too large, fold in the edges of the cornucopia and place it in a basket or other receptacle where it will not be pressed upon, have its tail damaged, or be shaken about. In a warm climate, avoid the use of a metal box for carrying birds, as they will become overheated. Decomposition of the skin results in a blistering or sloughing of the epidermis, loosening the feathers so that they fall out when the bird is handled.

Measuring Fresh Birds

The dimensions of bill, wing, and tail are usually measured from the dried skin, and there is no advantage in taking them from the fresh bird. In certain cases, particularly with large species, it is of interest to record the spread of wings, from tip to tip, and the total length, from tip of beak to end of tail. The "length of body" would be a useful measurement to take from every species; this would be the distance in a straight line from the anterior surface of the shoulder to the vent, or, if the bird is already skinned, to the tip of the small bone (pubis) which extends down in the belly wall close to the vent. In birds of ordinary size it may be measured with a pair of dividers. Always use the metric system in preference to inches.

Skinning the Bird

(1) See that the throat is tightly plugged with dry, non-absorbent cotton. Do not plug the nostrils, for the pressure

may change their form, which it is desirable to preserve. If blood oozes from the nostrils, place a strip of cotton over them and across the forehead, stuffing the ends down on each side into the throat, and then add another wad in the throat to hold them fast. This will keep most of the blood away from the plumage of the head during the operation of skinning. If the eyeball has been ruptured by the shot, pull it out with the forceps, and fill the cavity with meal.

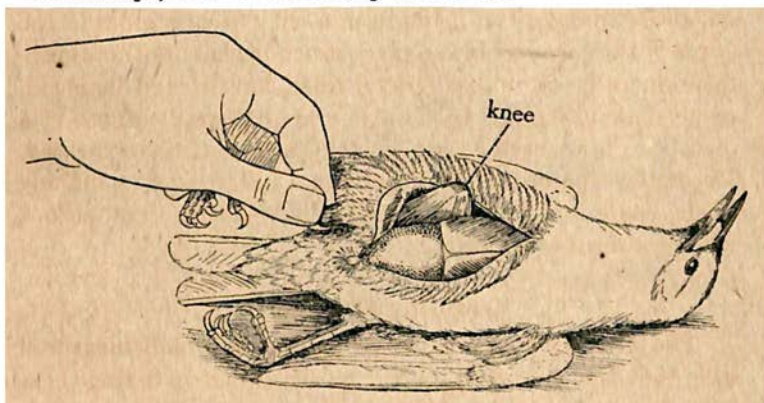


Fig. 2. The first knee has been exposed. Cut through joint and flesh, down to the skin.

(2) Lay the bird on its back. Separate the feathers down the mid-line of the breast, where the skin will be found more or less bare. With scalpel or scissors make a longitudinal incision through the skin, from about midway down the breast bone, backward to the vent, into which the cut may be continued. Try not to cut into the wall of the abdomen, although a small hole will not matter.

(3) Taking the very edges of the skin by the finger nails, and pushing with the handle of the scalpel between the skin and flesh, separate the skin from the body, farther and farther back on both sides, until you lay bare the bird's knees. Sprinkle cornmeal upon the flesh as it is exposed, to dry it, and to prevent the feathers from adhering.

(4) Take hold of one of the feet from the outside, push the knee farther up into view inside the skin, as in Fig. 2. With the scissors, clip the leg entirely in two at the knee-joint, inside the skin. Do the same with the other leg.

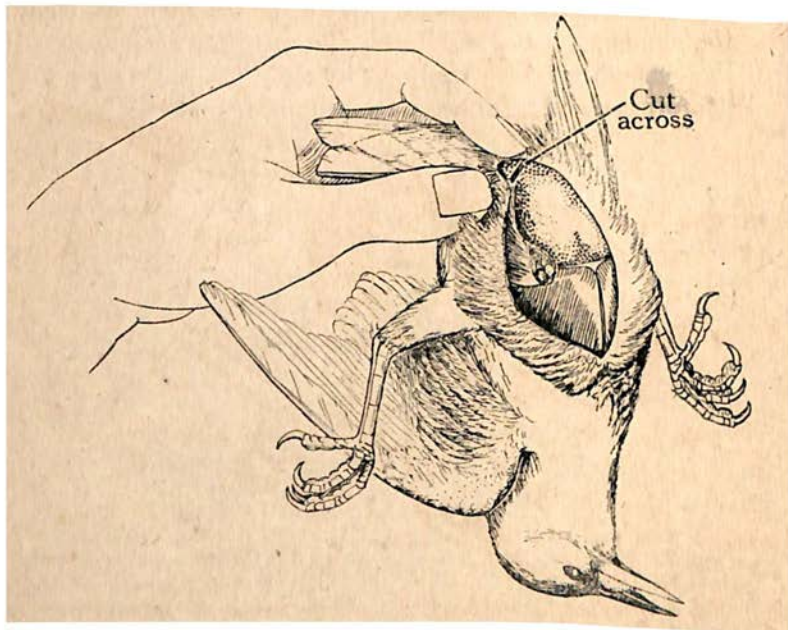


Fig. 3. While holding the base of the tail, press it upward with the second finger, and cut through with scissors to the skin of the back, on the line indicated.

(5) On both sides of the abdomen separate the skin as far as possible, and sprinkle meal. With the scissors, first cut through the lower end of the intestine, close to the vent, and then through the base of the tail, far enough forward to avoid the bases of the tail-quills. (See Fig. 3.) Continue until you see the skin all across, and the tail is completely severed from the body, inside the skin. A small hole may perhaps be cut accidentally, but remember that a small hole entirely under

the plumage matters little, and a larger one can usually be sewed together without detracting from the value of the specimen.

(6) With the left hand grasp firmly one of the thighs, to support the body of the bird. With the thumb of the right

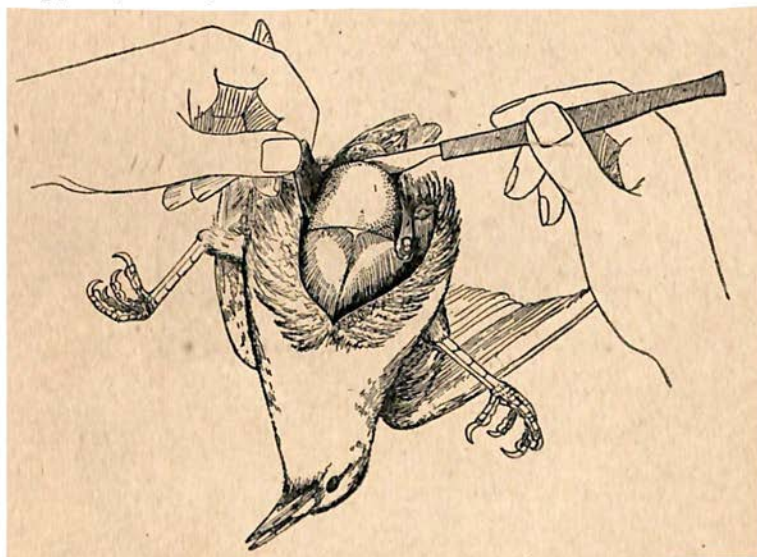


Fig. 4. Supporting the body by one of the thighs, skin forward over flanks and rump.

hand, aided occasionally by the scalpel, separate the skin of the rump from the body, as in Fig. 4. Continue forward, turning the skin of the specimen partly inside out, and removing the body gradually from the skin.¹ Use an abundance of meal to keep the feathers from being soiled, and try to keep the fingers interposed between the feathers and the flesh, as the work proceeds.

¹In the case of large birds, a cord may be tied about the body just in front of the thighs, as soon as the skin has been peeled off to that point, and the bird may then be hung at a convenient height. This saves the effort of supporting its whole weight with the left hand.



Fig. 5. The body has been almost entirely skinned, so that the bases of the wings are exposed, ready to be cut through at shoulder joint.

(7) The bases of the wings will soon appear. (Fig. 5.) Cut them off at or near the shoulder joint. Continue turning the skin forward. The neck is soon reached; and the skin will turn back easily over it, till the base of the head is reached.

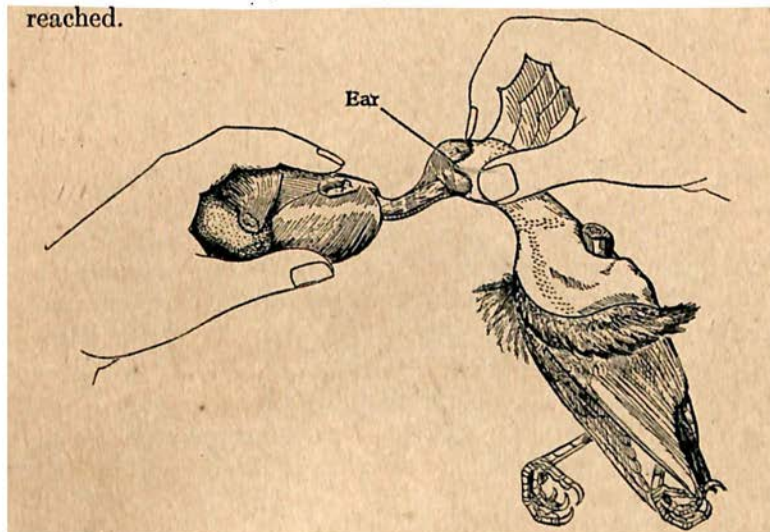


Fig. 6. Pushing the skin forward over the head. The ear has been reached, and its skin may be pulled out with the finger nails, or in a larger bird cut through close to the skull.

(8) Work the skin carefully over the head, *pushing* with the finger nails close to the skull, rather than pulling on the skin of the neck.¹ As the back of the head emerges, the ears appear (Fig. 6), and by seizing them firmly with the forceps or between the nails of thumb and index finger, they can be pulled from their hollows. Only in large birds is it necessary to cut the skin of the ears, as close to the skull as possible.

¹In many woodpeckers and ducks the head is too large to come through the skin of the neck. If after patient trial it cannot be persuaded, cut off the neck close to the base of the skull, and proceed as indicated on page 25.

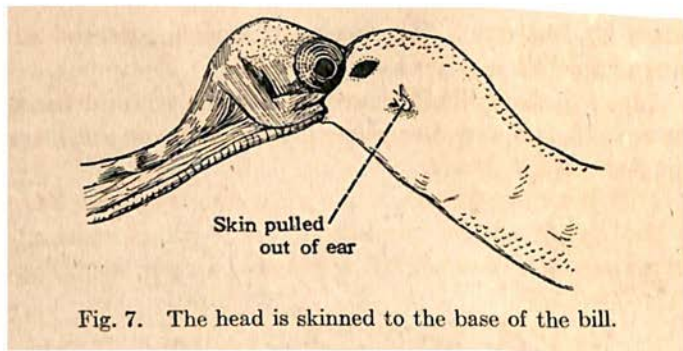


Fig. 7. The head is skinned to the base of the bill.

(9) Next the dark-colored eye-balls appear, and the thin transparent membrane is cut which attaches the eyelids to the eyeball. Continue cutting forward until the lids are completely free from the eyes, and above all avoid cutting the edges of the lids, which so often bear a circlet of small feathers.

(10) Continue skinning forward to the very base of the bill, above and below, as in Fig. 7. This is especially important in large birds, for it enables this part of the skin to dry and

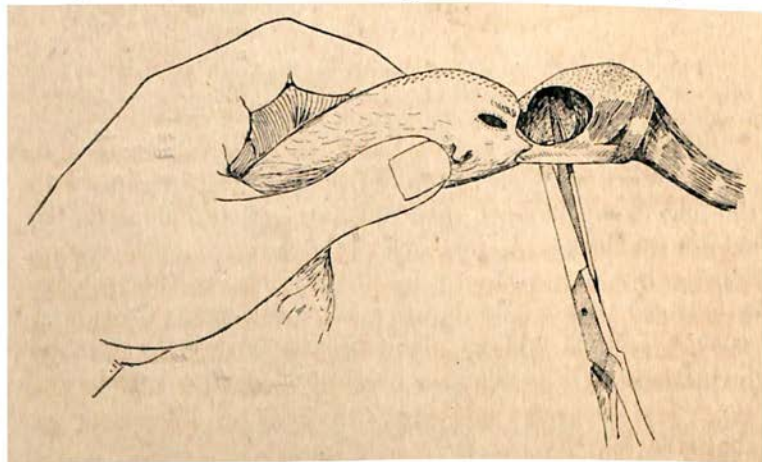


Fig. 8. The first cut for the removal of the brain is through the thin wall between the orbits, without injuring roof of skull.

retain its feathers. The skin must remain attached at the base of the bill.

(11) Pry the eyeballs from their sockets with the handle of the scalpel, but avoid breaking them. Cut away the tongue and floor of the throat.

(12) With the scissors make a cut directly across the roof of the mouth, below the orbits, but without cutting the lateral supports of either the upper or the lower jaws (Fig. 8).

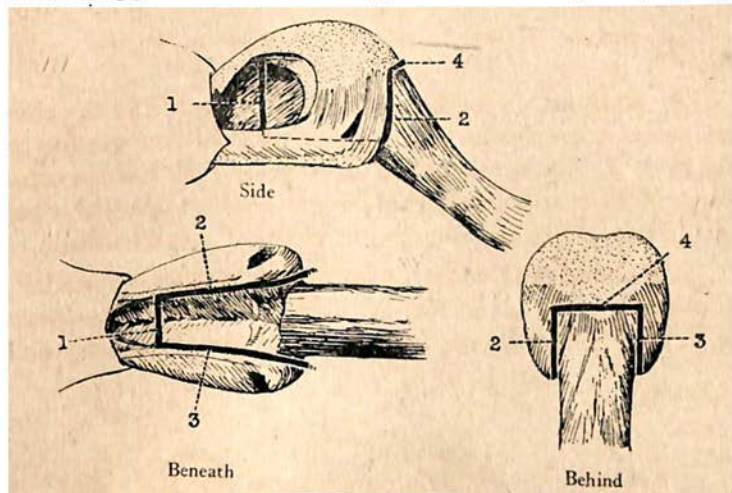


Fig. 9. Four cuts with the scissors suffice for the removal of the base of skull, and of the brain. These are numbered in the order in which they are made.

Again with the scissors, make incisions from each end of the preceding cut backward along the base of the skull, within the branches of the mandibles, as far as the rear of the skull, at the sides of the attachment of the neck. Connect the posterior ends of these cuts by a fourth, across the back of the skull, just above the juncture of the neck.¹ These cuts are shown in Fig. 9.

¹In large birds the same cuts are made in the skull, but with stronger bone shears, instead of the scissors.

(13) Pulling the neck from the head will now remove the base of the skull and part of the brain, the remainder of which is to be scooped out with the handle of the scalpel. Large openings should connect the brain-cavity with the orbits.

(14) Cut away any loose flesh from the skull, and powder it generously, as well as the skin of head and neck, with arsenic and alum, which is shaken from a piece of cotton held in the forceps.¹

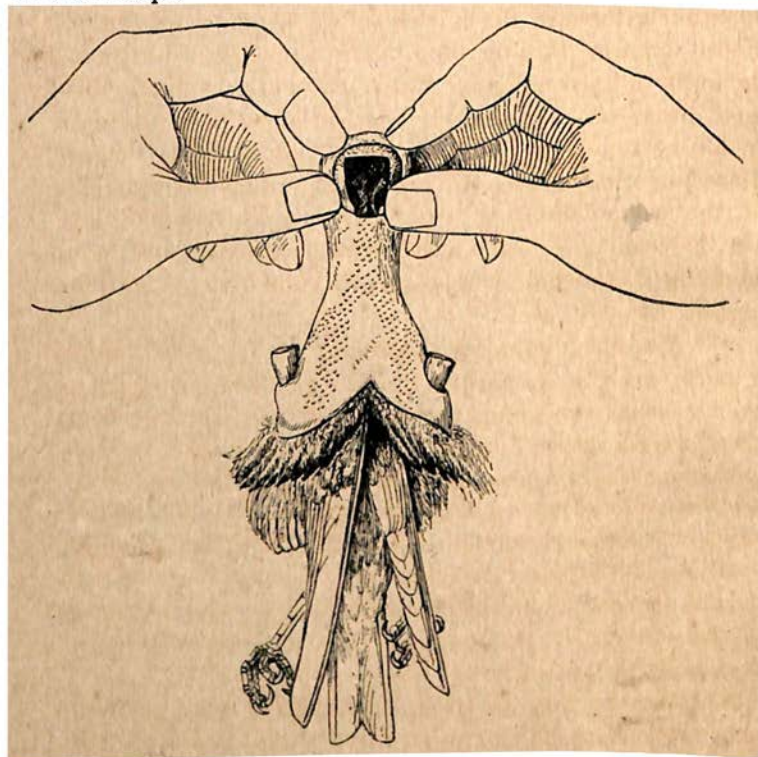


Fig. 10. Turning the skin of the head back over the empty skull, which has been cleaned and poisoned.

¹ A dried rabbit foot is even better for the purpose.

(15) If the skin has dried so as not to turn back easily, moisten it slightly. The head is now turned right side out, by gradual coaxing with the fingers, rather than by pulling. (Fig. 10.) No stuffing is as yet placed in the head. Straighten out the feathers with small forceps and a needle, especially about the cheeks and eyes.

(16) Pull the wing-bones inward, and clean the wings, one after the other. Push the skin away as far as the elbow. Then push forward the skin along the *upper* or *anterior* side of the forearm, leaving the quills (secondaries) attached to the lower of its two bones. The muscles of the forearm, in all small birds, can be removed from the upper side, almost as far out as the wrist. There is no objection to the removal of the upper of the two forearm bones (radius) when snipping out the flesh. The upper arm bone (humerus) should, however, be cleaned of flesh and left attached to the bone (ulna) remaining in the skin of the forearm. These bones are illustrated in Fig. 11.

(17) Another method of skinning the wing, which makes for more speed in preparing birds of medium size, such as pigeons, consists in separating the quills from the lower bone of the forearm with the scalpel. This allows greater freedom in removing the muscles of the forearm, but the bone of the upper arm should not be removed, and later the skin should always be pulled so that the wing-quills extend back again to the elbow. Otherwise the form of the wing becomes unnaturally distorted. In really large birds, the wing is opened from the outside, on its lower surface; and the quills must always be left attached to the bone.

(18) Before turning the wings right side out again, proceed to skin the legs, pushing the skin down as far as there are any feathers, and then removing all flesh from the bones. In large birds see carefully to the farthest (outermost) parts that are feathered, as they are very apt to decay, and give them an extra share of arsenic and alum. Do not attempt

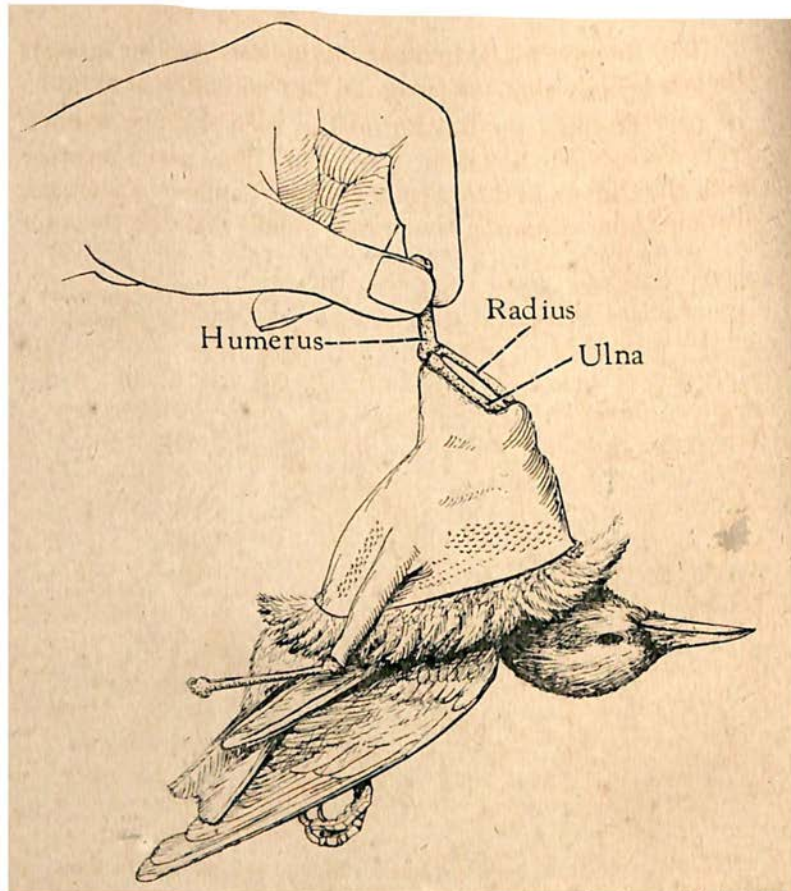


Fig. 11. The flesh has been cleaned from wing and leg; this treatment suffices for all small birds.

to turn over the scaly skin of the feet, as it will injure the scutes.

(19) Remove as much flesh as possible from the base of the tail, and cut out the fat of the oil-gland on its upper side. Avoid injury to the bases of the quills, or they will fall out. Most of the bone may be removed, except the very tip, between the middle feathers.

(20) Remove all fat and any bits of flesh from the inside of the whole body skin. (See page 26 for the treatment of fat.)

(21) Through the forward end of each scapular feather-tract a stitch is to be taken. (Fig. 12.) Draw them together with the thread, and tie firmly (with a "square" knot) at a distance approximating that which would separate them on

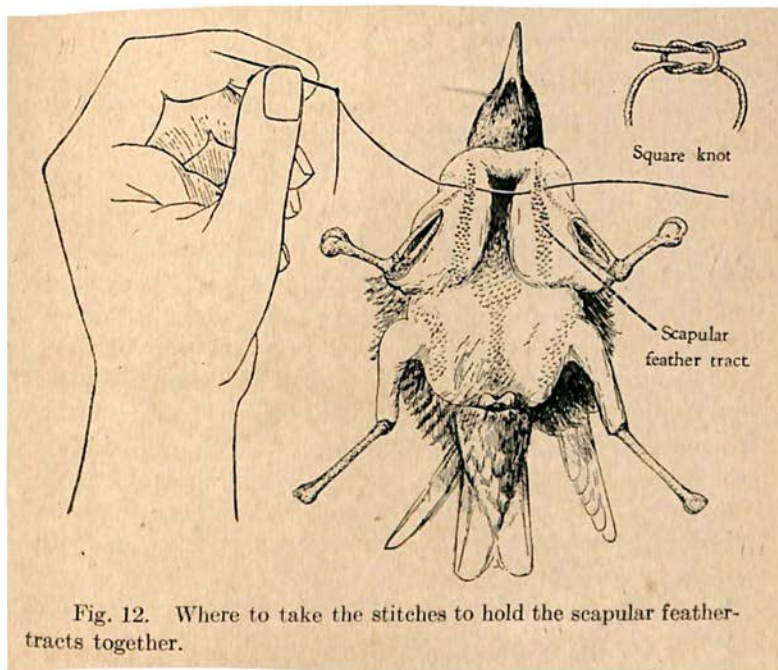


Fig. 12. Where to take the stitches to hold the scapular feather-tracts together.

the back of the live bird. This will make the arrangement of the wings and adjoining feathers vastly easier. Tying the wing-bones together is another means to the same end.

(22) Powder the whole inner surface of the skin, especially that of wings, feet, and base of tail with arsenic and alum. Wind a little cotton about the leg bones, and turn the whole skin right side out.

Cleaning the Plumage

(23) Look for any blood spots on the plumage, and wash them clean, using a small brush, rather stiff, dipped in clean water. When the blood has been entirely removed, the feathers are dried by rubbing them with dry meal, raising the feathers and brushing them lightly forward and back with the nail-brush. Add more meal, rub into the bases of the feathers, and repeat until the feathers are entirely dry. Then remove all meal by shaking and a vigorous use of the nail brush. When the cornmeal becomes damp it should be dried in the sun or over a fire.

Filling out the Skin

(24) Birdskins are not left flat, but are filled out to the size of the body removed, so as to show the relation of the plumage to the different parts of the body. First roll a fluff of cotton on the end of the fine-pointed forceps into a small hard ball about the size of the eye. Taking the ball firmly in the forceps, pass it up through the skin of the neck, through the back of the skull, and lodge it in the orbit. Another ball fills the other orbit, and a little cotton in the brain-space holds them firm. The eyelids are arranged from the outside with a needle, as though the eyes were wide open, so that a smooth cotton surface shows.

(25) The stuffing for body and neck is put in together. On a soft iron or brass wire¹, somewhat longer than the stuffing is to be, roll cotton first in the form of the neck, tapering to a point anteriorly.² Farther back more cotton is tightly rolled,

¹A slender, pointed stick may be used instead, though less convenient. In making up the skins of very small birds it is scarcely necessary to use either stick or wire. The cotton may be wound on a thin knitting needle, which is loosened by a reverse twist and withdrawn, after the stuffing has been arranged inside the skin.

²Dip the wire in water first, if necessary, to make the cotton adhere tightly.

until it approximates the size of the body you have removed. (Fig. 13.) It must never be larger. The cotton neck protruding from the cotton "body" should not exceed the length of

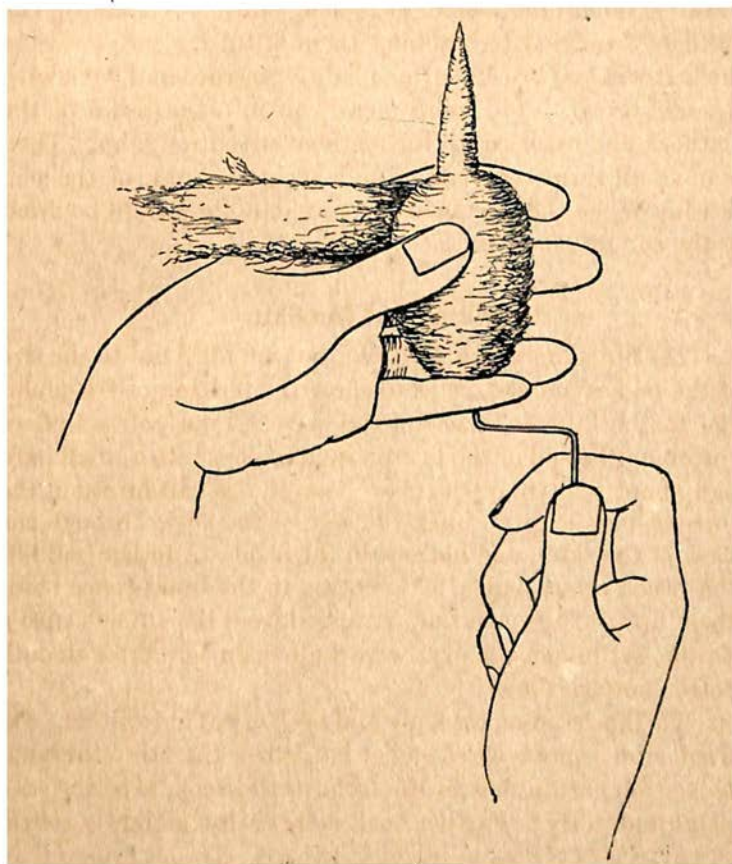


Fig. 13. Rolling the artificial body of cotton or tow on a wire.

the bird's neck as it lies before you, for though it will run up into the throat, it cannot bend into the natural curve of the neck of the bird.

(26) Open the skin and insert the pointed anterior end of the stuffing (at tip of wire or stick), running it up the neck and into the throat, until its tip appears in the mouth. Pull back the skin of the bird until it encloses the cotton body. (Fig. 14.)

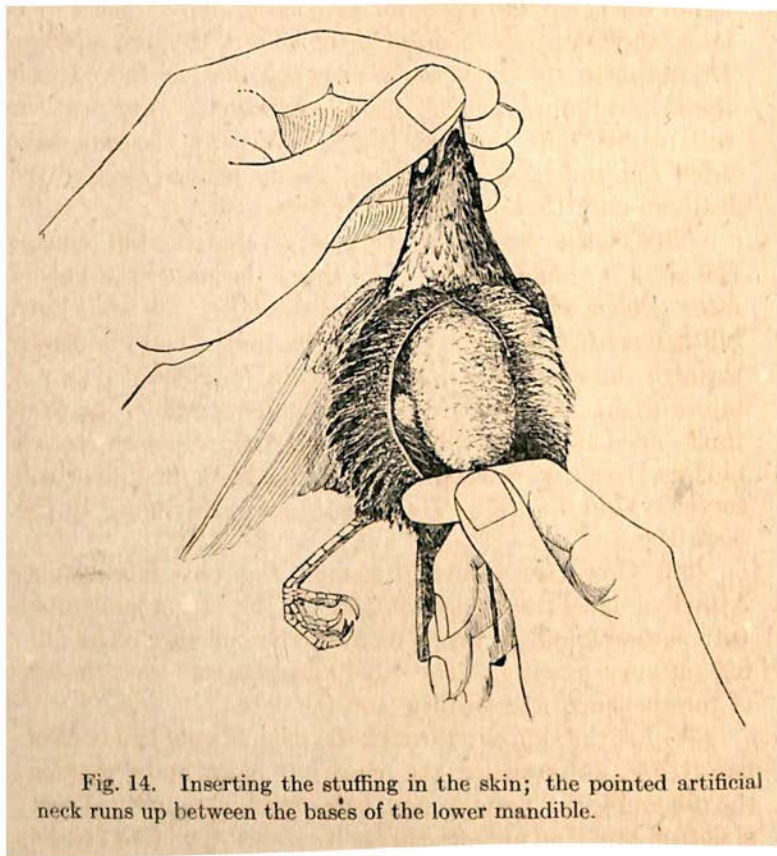


Fig. 14. Inserting the stuffing in the skin; the pointed artificial neck runs up between the bases of the lower mandible.

(27) You are now ready to arrange the skin properly with the forceps, folding the wings close to the body and on the back rather than down on the breast, and pushing the skin of chest and hind-neck forward or backward, as the smoothing of

the plumage may require. The skin of the ear-region or crown may be raised with the point of a fine needle and moved about slightly until the feathers all lie naturally.

(28) Once you are satisfied with the general appearance, which should resemble that of a dead bird lying on its back, cut or break off the posterior, projecting part of the wire or stick, and sew up the incision of the belly with a few stitches.¹ Do not draw the sides too closely together, as the edges of the skin will always have shrunk somewhat. The feathers will readily hide the slit. If the borders of the skin have dried too much, moisten them inside before sewing; the feathers may then be more easily arranged.

(29) Tie the mandibles together, so that the bill remains closed as it would in life. The tip of the upper one should often project very slightly beyond the lower. A well-closed bill is essential to a good skin. The thread may be passed through the nostrils with a fine needle, provided it does not injure them, and tied around the lower mandible. In very thick-billed birds the thread may not hold; in such cases a pin inserted between the rami of the lower mandible will serve to shut the bill. Here, too, beware of injury to the nostrils.

(30) Cross the legs and extend the toes moderately. Attach a label (see page 36), tying the string preferably with square knots, so firmly as to leave no chance of its falling off subsequently. The label must bear at least the sex of the specimen, the locality, and the date.

(31) Let the skin slip through the palm of your half opened hand (Fig. 15), pressing the wings into place, and arranging the tail and legs. Lay the skin, back down, upon a thin sheet of cotton broad enough to enclose it. Draw the lateral edges of the cotton up around the sides, as in Fig. 16, so that they hold in the wings and enfold the whole skin, overlapping on

¹In very small birds one stitch is enough.

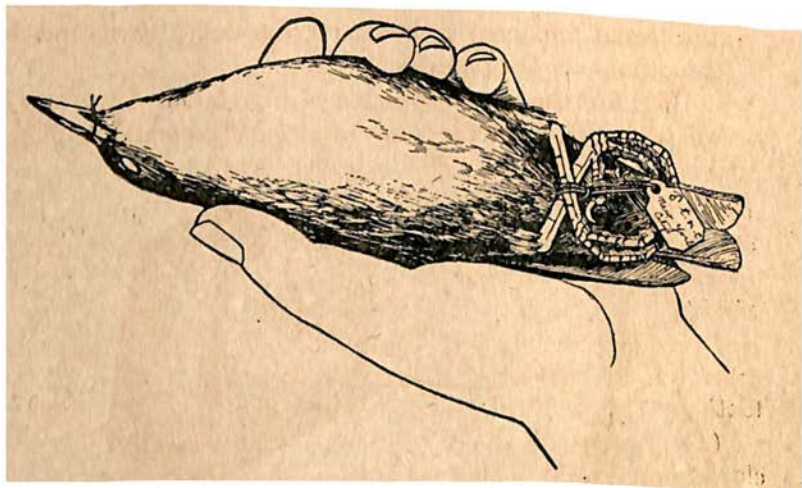


Fig. 15. The finished birdskin is molded in the palm of the hand, the wings being pressed in against the back, so they do not hide the sides of the breast.

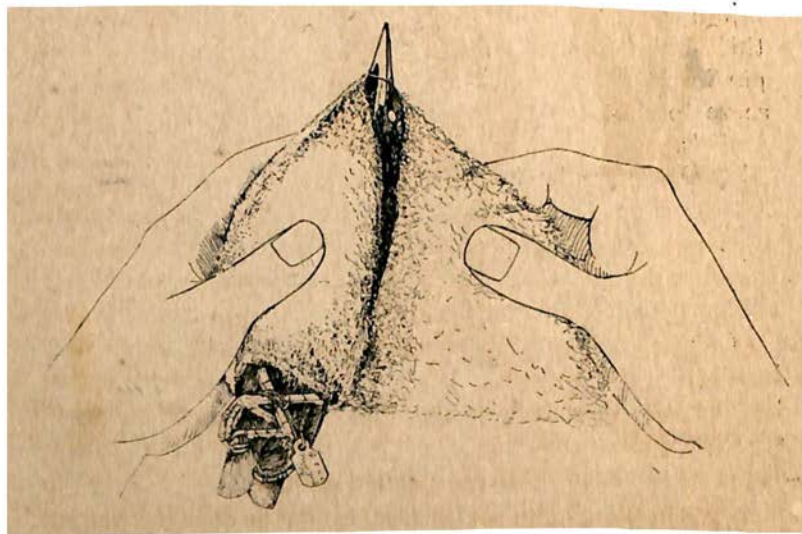


Fig. 16. Wrapping the finished skin in a thin sheet of cotton, before it is laid away to dry.

the throat and breast, preserving the desired form and the smoothness of the plumage.¹

(32) Put the skin away in a cool airy place to dry, where it will be safe from insects or any other small animals that might destroy it. (See page 38 for drying racks.)

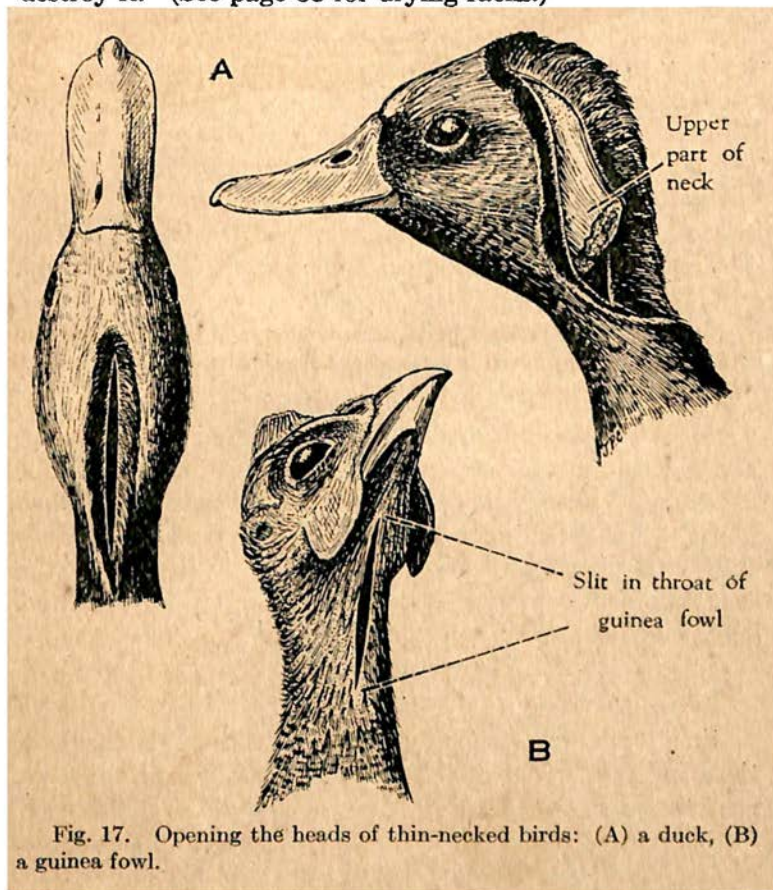


Fig. 17. Opening the heads of thin-necked birds: (A) a duck, (B) a guinea fowl.

Large-headed Birds

When the skinning of the head cannot be done through the neck, as in the case described on page 13, the neck alone is

¹Instead of wrapping with cotton, some collectors prefer to push the finished skin, bill foremost, into a cornucopia or a cylinder of paper.

removed, the skin turned right side out, and a slit is cut between the feathers from the middle of the crown as far back on the nape as may be necessary to allow turning out the skull and the removal of eyes, brain, and all flesh about the head. (Fig. 17, A.) The same cuts are made in the base of the skull as in the usual procedure. Through the slit in the skin of the nape the necessary stuffing is afterward introduced into the orbits, and a little cotton may be placed between the skull and the skin of the cheeks, if much flesh has been removed. Then the slit is sewed together again, and will usually be hidden by the feathers. When a considerable amount of flesh has to be removed from the skull of a large bird, it is well to replace it by inserting pads of cotton with the forceps just before the skin is filled out again.

In a few cases the slit is better made on the lower side along the mid-line of the throat. Birds like the horned Guinea-fowl are best treated this way (Fig. 17, B), for the excrescence on the crown must not be separated from the skull. The head cannot be completely skinned; but the soft parts of the throat, the eyes, and the brain can be removed from below. The fact that the slit remains visible is of no moment. Hawks and other diurnal birds of prey have a bony shield over the eye, projecting from the region of the forehead. It is best kept attached to the skull.

Fatty Birds

Small patches of fat may be removed from the inside of the skin by scraping with the scalpel, enough cornmeal being used to prevent the oil from reaching the plumage. Waterfowl are often so greasy that the removal of the fat is almost certain to soil the feathers. It must never be left on the skin. Scrape away from the tail and in the direction of the head; far fewer holes in the skin will result. The cornmeal or other absorbent powder (see page 6) may be heated in a pan over a fire (though never hot enough to scorch the feathers) and it

will absorb oil much more effectively. Where gasoline, benzine, or naphtha is available, the skin after careful scraping may be dipped and washed in any of these fluids, and then dried by shaking meal into the feathers and beating and brushing gently. For small birds, carbon tetrachlorid (often sold under trade names such as "Carbona") may be used to the same purpose and without danger from fire. These degreasing fluids must not be expected to remove dried blood at the same time; that should previously have been sponged off with water. Many taxidermists, in preparing fatty water birds like ducks, prefer to make the initial slit in the body skin down one side, beneath the wing, instead of on the middle of the belly. The short dense feathering of the underside is more easily arranged afterward; and the plumage along the mid-ventral line is preserved from soiling by grease. Such a procedure is seldom necessary, but by no means objectionable.

Wings and Feet of Large Birds

Special attention is required by the wings and feet of large birds, for with only the treatment described above, they would be certain to decay and lose feathers or scales before they could be dried. In warm climates especially, every bird as large as a partridge must have a slit made along the underside of the wing, out to the tip, in the line where fewest feathers grow. (See Fig. 18.) Then all fleshy parts and large tendons are removed. The bases of the large quills (secondaries) are not to be separated from the bone (ulna), for this would make their subsequent arrangement difficult—particularly in a large bird which is to be mounted. It is especially important to separate the skin of the wrist joint, around to the upper surface of the wing, from the bones at that spot, and to insert a generous dose of arsenic and alum. Failing this, in large birds, the feathers of the "bend of the wing" are more than apt to become loosened through "sweating" of the skin.

The slit of the lower surface of the wing may be closed with a few stitches, but drying will be more rapid if it is not too carefully sewn up. Try to keep the feathers near it clean. In large birds that require such treatment, it will be necessary also to wrap the bone of the upper arm with cotton or tow, to keep it from contact with the skin, for drying will be slower than in small birds.

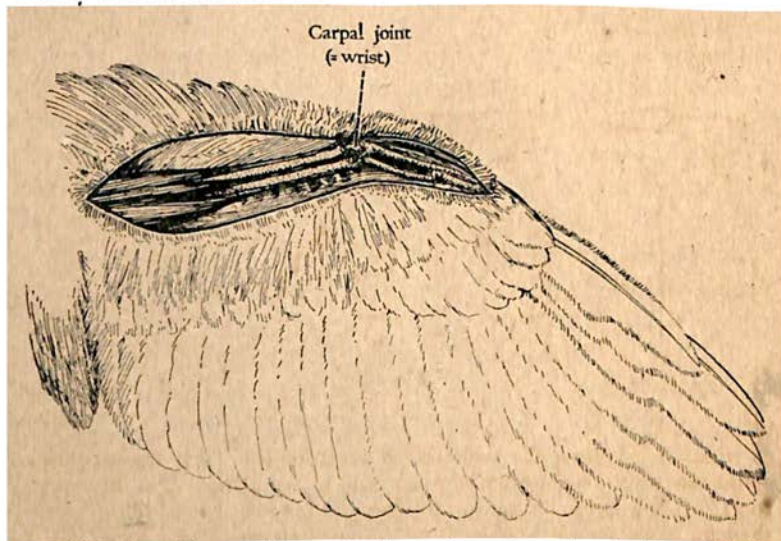


Fig. 18. The opening made along the under side of a large bird's wing, for the removal of flesh. Be sure to skin around over the *upper* side of the wrist joint, and poison well with arsenic.

The feet in large birds dry so slowly that the skin often decomposes, and the scutes become loosened. To obviate this the tendons of both tarsus and toes are removed, together with any small muscles present. After all the other skinning operations have been completed, cut a longitudinal slit in the median pad of the sole. The tendons of the toes all converge here, and by pushing the tip of the heavy forceps beneath them, from the side, they may be pulled entirely out of

the tarsus. (Fig. 19.) The ends attached to the toes may then be cut, or if the toes are very fleshy, they also may be split open longitudinally from below, and more of their tendons excised.

With large herons and other similar wading birds, another slit should be made on the *inner* side of the heel joint (near the upper end of the shank), parallel to the long axis of the

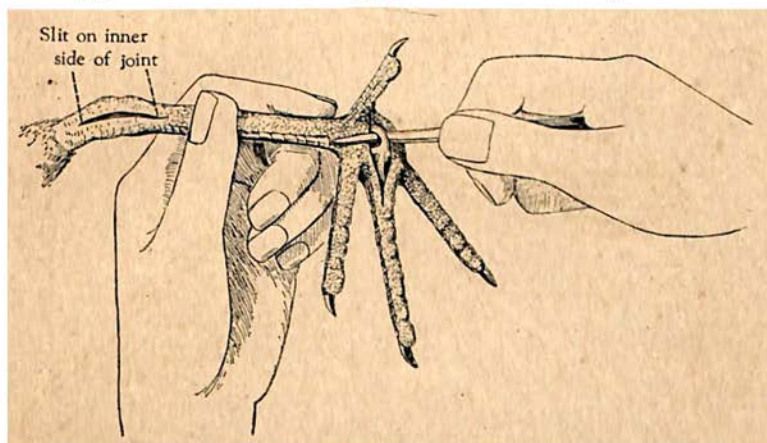


Fig. 19. Pulling the tendons from the leg of a large wading bird. Note also the incision on the inner side of the shank, near its upper joint. It need not be made till after the tendons have been drawn; through it the skin is loosened and poisoned all around the joint.

limb, and the skin separated as far around the joint as practicable, to be treated with arsenic and alum. With a wire or the long forceps, get as much of this preservative as possible up into the space whence the tendons have been withdrawn.

The feet of pelicans and large vultures are so difficult to preserve in a warm moist climate that the safest way is to slit the skin down the whole length of the tarsus, on its inner side. Remove all flesh and tendons, dust with arsenic and alum, and do not sew up very tightly. Split the underside of the toes, out to the last joint, removing the tendons.

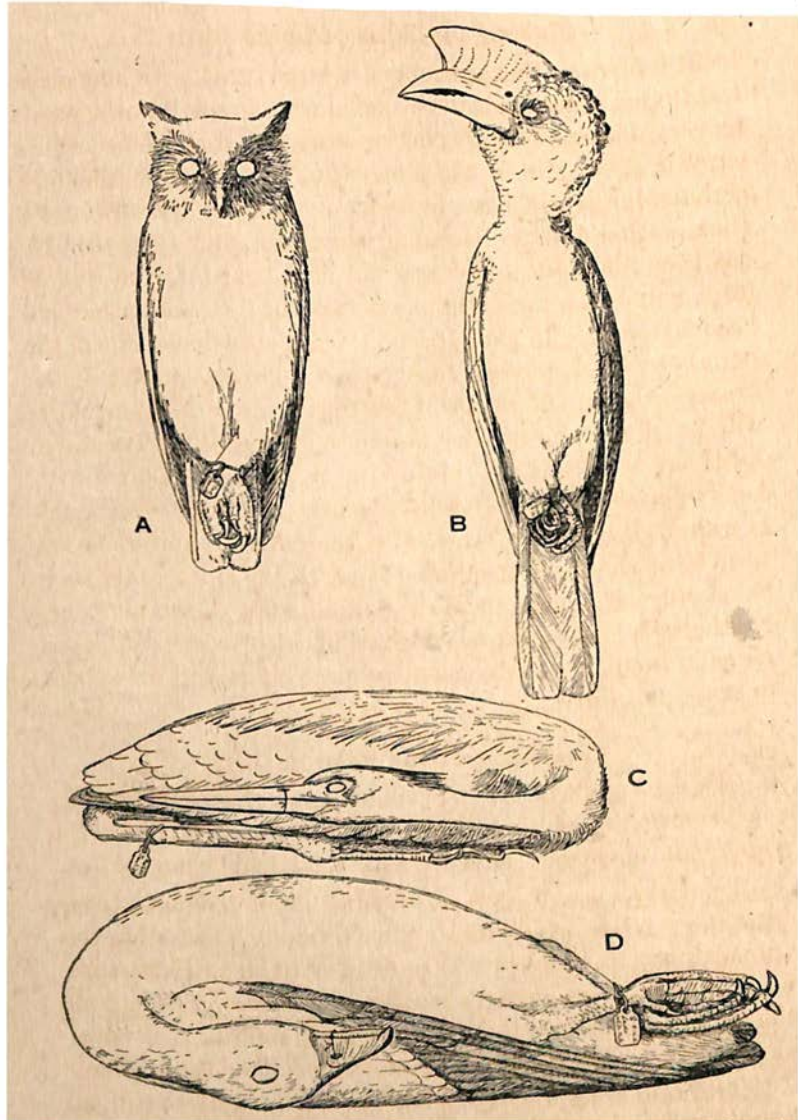


Fig. 20. Method of arranging skins of some large birds. A, owl, B, hornbill; C, large heron; D, goose.

Making up Skins of Large Birds

It is obvious that specimens of large birds, with long necks and limbs, if made up in the same way as small birds, would be very difficult to transport or store in boxes. When a bird exceeds a length of $2\frac{1}{2}$ feet, either the neck or the feet, perhaps both, will have to be doubled over. A wire, not a stick, is therefore to be put in the neck; and after the skin has been filled out and sewed up, it is bent into the desired form, care being taken that no part of the bird's plumage shall become entirely hidden. Bend the neck down one side of the body, outside the wing, rather than upon the middle of the breast or back. Methods of treating birds of different sorts will be suggested by the sketches in Fig. 20. For large birds the artificial body, preferably of "excelsior" bound with heavy thread, is made smaller than the real body. The neck is wound of cotton or tow, and these softer materials are used to fill the space remaining beneath the skin. Make such skins only large enough to display all parts of the plumage. Neither can large skins be wrapped in cotton; strips of paper pinned round them, or some open-mesh cloth, will keep them in shape until dry.

Treatment of the Head in Owls

The eyes of Owls have a peculiar shape, the front protruding in such a way that if the whole orbits are filled with round balls of cotton, the facial expression will be largely lost.

Treat the eyes of owls as follows: Do not remove them from the orbit, in which they are fixed rigidly. Cut away the transparent skin (the cornea) in front of pupil and iris; then with the small forceps and a small wad of cotton force out all the liquid from within the eye, drying the interior with corn-meal. Take care that the liquid does not fall on the feathers.

The brain is removed through the base of the skull as usual; but there will be no opening from the brain-space to the orbit, for the latter is still filled by the shell of the eyeball, as in Fig. 21.

So instead of stuffing out the eyes from behind, round lumps of cotton are wedged into the front of the emptied eyeballs, through the lids, after the skin of the head has been turned back, and when the skin is finally being filled out.

The false neck, with its stick or wire, is not inserted into the throat of an owl, but is wedged tightly into the brain-

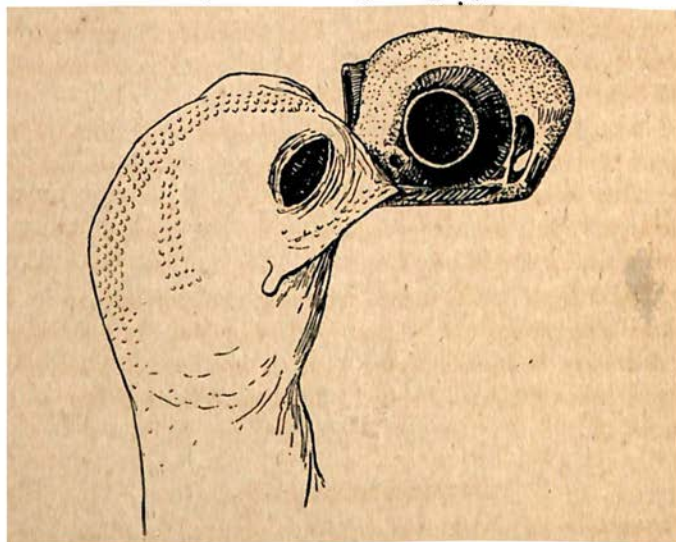


Fig. 21. Owl's head after skinning and cleaning; to show the way the empty eyeball is retained.

space at the back of the skull. This will bring the head and face into a far more owl-like position. (Fig. 20, A.) A projecting wire point may be left at the anterior end of the false neck, to be pushed through the top of the skull and bent over outside the skin. It will hold the head on more securely.

Temporary Preparation of Some Large Birds

The large flightless birds such as the ostrich, cassowaries, and their allies are not to be prepared according to the foregoing method, but must be treated more as a large mammal

would be, though the bones of wings and feet, and the skull are retained. The feet especially are to be more fully skinned so that the skin nowhere lies closely against the bone. Only just enough hay or other dry stuffing is used to keep the two sides of the skin apart, and no cuts are sewn up. Instead of arsenic and alum use salt, in a dry climate, or one part salt to three of alum in a humid one. Dry the skin as thoroughly as possible, and fold into a bundle. Never pack in the same box with other skins not treated with salt.

Large, greasy seabirds, and fatty ducks or geese, often impose serious delays upon the collector. To save valuable time they may be skinned out completely, and thoroughly salted, without too close attention to the grease, provided blood stains are carefully removed. Their preparation can be completed by a taxidermist even several months later. In general this procedure is not recommended, for the longer the skins are kept, the more work is involved in their subsequent preparation. In the humid tropics it is not to be thought of.

Determination of Sex

Inspection of the plumage can in no case be relied upon for the bird's sex. Dissection is the only method; and where wounds or incipient decomposition have destroyed the evidence, do not write the sex upon the label without a question mark.

When the body is completely removed from its skin, cut open the left side from the vent to the anterior ribs. Force the edges apart, and pressing the intestines aside, look for the sexual organs, which will be found in the small of the back close to the backbone, and near the forward ends of the kidneys, which fill the roof of the abdominal cavity. They are shown in Fig. 22.

The male organs (testes), two in number, are usually dull white but occasionally much darker, and lie side by side.

They are of smooth rounded or ovoid form, large and conspicuous in the breeding season; but they may become extremely small in winter. Do not confuse them with the "adrenal bodies," smaller and flatter bodies (yellow or orange), lying a little farther forward, in the forward border of the kidneys.

The female organs consist usually of a single ovary, lying a little to the left side. A vestige of the right ovary may be present. In the non-breeding season the ovary is a mass of

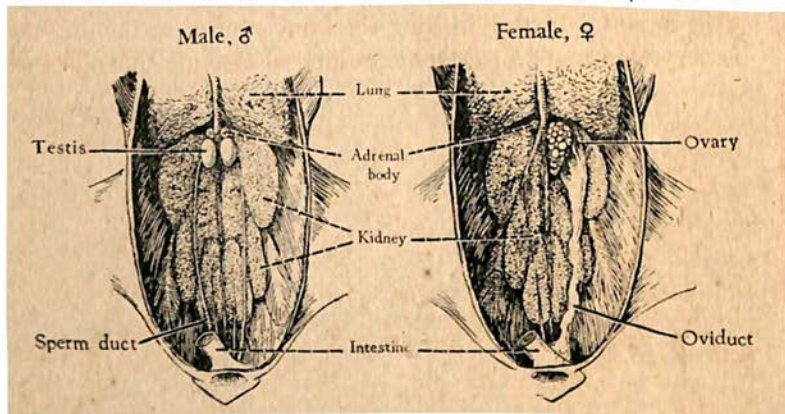


Fig. 22. Dissections of male and female birds, to show the reproductive organs, by which the sex is recognized, and adjacent structures.

small ova or rudiments of eggs, much less regular in shape than the testis of the male, and likely to be flattened, with evident granular structure. The female has adrenal bodies the same as the male. As the time for laying approaches, some of the ova become greatly enlarged, to form the yolks of the eggs. At this time too, the oviduct, a tube leading from the neighborhood of the ovary down the left side to the vent, becomes conspicuous—being usually whitish.

Determination of Age

From the condition of the sexual organs, and that of the bird's whole body, the bones in particular, the collector ought

to be able to detect signs of immaturity far more accurately than is possible from a dried skin. He might note his opinion on the label, using "ad." for adult, and "im." for immature, the latter designating any bird which has not assumed its full plumage.

Fortunately there is a simple method of determining, in the case of practically all perching birds (=ordinary song-birds and their near allies) whether the specimen is a bird of the year or not. In the nestling the bony roof of the brain-case is very thin and transparent, formed of a single thin sheet of

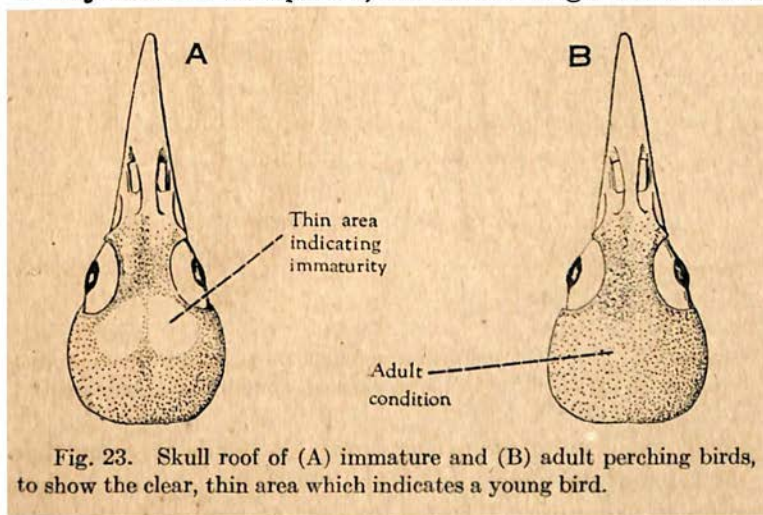


Fig. 23. Skull roof of (A) immature and (B) adult perching birds, to show the clear, thin area which indicates a young bird.

bone; that of the adult is more opaque, being formed of two layers of bone, separated by air spaces traversed by fine bony rods. Holding an adult skull up to the light, after removal of the brain, one will note that the roof of the skull, back of the eyes, shows fine dark specks all over. (Fig. 23, B). By reflected light these specks may look lighter than the neighboring bone.

As the young bird develops, the transparent area of the skull top becomes restricted, the dotted structure appearing

around its edges, especially behind, until after three months there is only a relatively small area where a single layer of bone persists. (Fig. 23, A.) This is usually near the mid-line, just behind the orbits; but in some families such as the swallows the last traces of these areas are found farther back, and more laterally placed. After some six months this sign of immaturity is completely lost.

Perching birds which are thus found to be immature should be noted on the label or in the field catalog as "s.n.o." (=skull not ossified); others which have skulls of adult structure, "s.o." (=skull ossified).

Do not attempt to use this method for other groups of birds until by careful study it is found reliable. Woodpeckers and other families of small birds may have skulls of such different structure that it cannot be applied.

Notes on Stomach Contents

Information which one may wish to preserve as to the habits of a bird should certainly include the results of examination of stomach and crop. The ornithologist will seldom be competent to name accurately all the insects, other animals, or fruits which have been eaten. It will nevertheless be worth while to have a list of the insects arranged according to orders or common names and numbers of individuals consumed, or brief mention of the nature of fruits or other objects swallowed. In the case of any species whose diet offers particular interest, the stomachs may be removed entire, labeled to correspond with the individual specimen, and preserved in alcohol or formalin, for future examination by experts at home.

The Label

The label is tied securely to the crossed feet of the birdskin, as described on page 23. As a rule the collector's label need not exceed 1 or $1\frac{1}{2}$ inches in length and $\frac{1}{4}$ inch in width. It

will remain attached to the skin even when a museum label is added later. When writing on either side of the label, always keep the string to the left; this facilitates its reading. Examples are given in Fig. 24.

(1) Sex.—The spear and shield of Mars (♂) are used as the sign of the male sex, the mirror of Venus (♀) as that of the female.¹

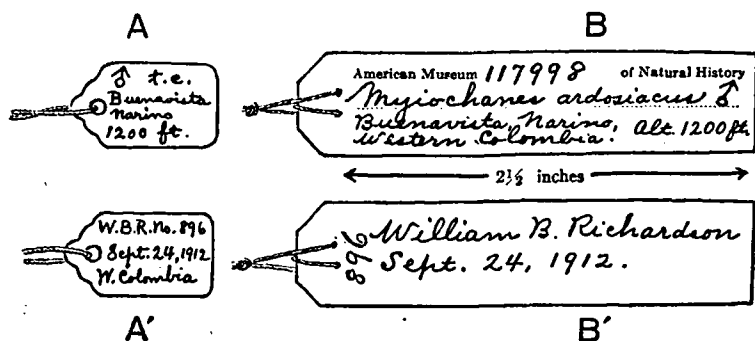


Fig. 24. Sample labels: A, front, and A', back of collector's tag; B and B', front and back of permanent museum label.

The condition of the reproductive organs is of interest as indicating sexual maturity or the reverse, of the individual, as well as the season of reproduction. It may be noted on the field label by means of the following abbreviations:

"t.e." = testes enlarged, when the increased size would indicate that breeding was under way.

"t.n.e." = testes not enlarged, when there is no possibility of the bird being in condition to breed.

Intermediate conditions may be indicated by "t.so.e." (=testes somewhat enlarged), and "t.sl.e." (=testes slightly enlarged). Corresponding conditions of the ovary would be written "o.e." "o.n.e." and so on.

¹Museum experience shows the necessity of writing the sex mark with the greatest care. The worst offence, perhaps, is the use of an inverted ♀ to mean male.

(2) Locality where the bird was taken, not abbreviated so as to be unintelligible save to the collector himself. Always give the state or country; as well. In mountainous regions the altitude is an essential adjunct to the locality.

(3) Date when the bird was taken. Do not use an Arabic numeral to indicate the month, for different usage in America and in Europe often makes it impossible to decipher. Even a Roman numeral is not so clear as a three-letter abbreviation of the name of the month. Every letter on the label must be written legibly.

These three items must never be omitted from a label, for a simple catalog number on the field label is of no interest if the notebook with the data is lost. But since it is advisable to have a field label of small size, the more lengthy remarks as to age, ripeness of the reproductive organs and color of unfeathered parts (eye, beak, feet, and any naked skin) may be confided to the field catalog. In general, however, the more information on the label the better. 7×9 inches is a good size for the notebook. In it one may add anything that seems of interest with regard to the bird's habitat, its food, nesting, migrations, and ecological status. In the field notebook write on only one side of the sheet, so that pages or parts of them may be cut out and reassembled, if desirable, according to species, at some future time. This will save the trouble of recopying half of the writing.

The Drying of Birdskins

Use every means to dry the specimens promptly, without exposing them to excessive heat. In a dry or cold climate there is no difficulty, but in a tropical rainy season it may become necessary to place them in the sunshine as often as the clouds part, or to hang them in the neighborhood of a fire, though not in the smoke. Never place them in air-tight boxes till thoroughly dry. Some sort of a crate enclosed with wire-gauze will protect the specimens from mice and insects

meanwhile, or they may be placed on flat rectangles of substantial wire netting, swinging shelf-like, one above the other, by strings attached to their corners. Such shelves should fit in one of the trunks or boxes, so as to be stowed away in the bottom when not in use. Insects may be discouraged from climbing along the cord which sustains such a drying rack by wetting it with kerosene or coal-oil.

For traveling there is nothing so effective as a specially constructed drying box, with open spaces on several sides, covered with wire gauze, and fitted inside with several light trays, of varying depth. The bottom of the trays is of wire netting, and they are crossed by upright slats to keep the birdskins in place. A waterproof canvas cover will keep off rain, on the march; and it may be put over the box at night to lessen humidity. Beware of small ants which invade the drying box and eat small holes everywhere in the specimens. Naphthaline flakes sprinkled over the skins will protect them temporarily.

Beetles (*Dermestes* and allies) will often gnaw at the horny sheath of the bill or the scutes of the feet, while the skins are drying. A simple way to discourage them is to paint all such parts, as soon as the specimen is made up, with a thin solution of arsenical soap, which will dry and leave almost no trace. Insects seem to be aware of the presence of the poison without tasting it.

Arsenical soap for this purpose may be made by boiling white arsenic powder a few hours in a thick solution of laundry soap—in an old pot, and *out-of-doors*—until all the arsenic is dissolved or at least held in suspension. The proportions may be about one tablespoon full of arsenic to a small cake of soap.

Packing of Birdskins

A soldered tin box encased in a wooden one is the ideal packing, but is seldom available and rarely necessary. Wooden packing boxes may be made sufficiently tight; and

if plenty of naphthaline flakes or moth-balls of the same chemical be scattered within, they will need no further inspection before arrival at their destination. Besides preventing the ravages of insects, naphthaline has a beneficent action in discouraging mold, if used generously.¹

Never pack birdskins permanently till they are thoroughly dry. A single moist skin of a large bird may do great harm to the rest of the contents of a box. Never pack in the same box any other skin which has been treated with salt, for should it pass through a rainy district the salt will inevitably absorb moisture. Salted skins of large mammals must be kept by themselves.

Burlap dipped in tar is often used to envelop bales of goods shipped to the tropics, and this material tacked over the outside of the box will give a decided protection from rain and from the attacks of termites or white ants. The box may be lined with it, provided that plenty of paper is added to prevent the tar from touching the specimens.

The individual birdskins, with or without their cotton wrapping, are rolled in cylinders of paper and packed tightly enough to prevent any displacement during transportation. If rather thin paper is used, and the smaller specimens are placed carefully in the hollows left between the larger ones, it is astonishing how many will go into the box. This is often of prime importance in overland transportation.

Skeletons or skulls must not be packed with birdskins unless the bones have been poisoned with arsenic, provided also that there is plenty of naphthaline to deal with the insects which are almost certain to be introduced with such bones. No heavy object is to be included in a box of birdskins, for it will shake about and break many of them.

¹Paradichlorobenzene (of which "globol" and "paracide" are trade-names) is a more energetic insecticide than naphthaline, but it evaporates far more rapidly than naphthaline, and is therefore less suitable for field work.

Customs Regulations on Entering the United States

With few exceptions the importation of wild birds' skins or plumage is forbidden, save when they are intended for scientific purposes, and addressed either to a museum or to a person holding a Federal permit to collect birds in the United States. Do not try, therefore, to bring them through as baggage, without special declaration. Specimens for the American Museum of Natural History should be clearly addressed to the museum, and may be safely turned over to the Custom Office at the port of entry, if so demanded. Notify the Director of the Museum, at the same time, of the arrival of the collection.

Preservation in Fluid

The colors of the plumage may change when the bird is thus preserved, so that the specimens are of use only for anatomical study. The preserving fluids used are alcohol (about 85%), or formaldehyde (=formalin) at about 3%. Alcohol is preferable when available; some kinds of denatured spirit will serve satisfactorily, provided they do not become cloudy on mixing with water. Strong commercial formalin is usually a 40% solution. Mix one part of such formalin with 15 parts of water. Adding common salt (two tablespoons per quart of formalin solution) prevents the extreme hardening so common with formalized specimens.

The preserving fluids must penetrate the interior of the bird's body. The abdomen and all the larger fleshy masses may be injected with a large hypodermic syringe, if it is to be had. Usually a simple slit through the wall of the abdomen, without disturbing the viscera (intestines, etc.), will allow sufficient penetration by the preservative.

Each specimen should have a label, bearing at least the locality and date. The sex will not be determined until the bird is dissected at home. The label may be of stout paper.

which is not affected by fluid, or it may be a tag of pure sheet tin or of lead, with a number stamped on it. Data may be written on paper either with a soft lead pencil, or with waterproof India ink, the latter being thoroughly dried before immersion.

Alcohol in which fresh birds have been dropped will absorb water from them, and become weaker. It is necessary to change it for fresh alcohol before packing for shipment. A few spoonfuls of strong formaldehyde may be added to strengthen a formalin solution, but this is seldom necessary.

For small birds in fluid, glass jars such as are used for preserving fruit will generally suffice, if they are surrounded when shipped with straw or other fiber. It may often be necessary to place the specimens in tins,¹ which need not be entirely filled with fluid when they are soldered up, provided the birds have been thoroughly preserved for some time. Soldering is not a difficult task if a few rules are borne in mind. The metal to be joined must be clean and bright. The point of the soldering-iron must be clean and have a film of molten solder adhering to it. To assure the adhesion of the molten solder both to the soldering-iron and to the metal to be joined, use a strong, reliable flux such as hydrochloric (=muriatic) acid into which a bit of zinc has been placed. "Soldering pastes" may work, but often fail when one is least able to replace them with acid. To keep the tip of the soldering-iron clean, during the course of the work, it may be rubbed occasionally on a block or lump of sal ammoniac.

The specimens must not shake around in the jars or tins. Pack them tightly, and wrap if necessary in pieces of cheesecloth.

¹"Friction-top" tins are the most convenient, but others will serve as well, especially with formalin.

Preparing Rough Skeletons of Birds

Large birds will generally have their bones preserved in this manner. Thorough cleaning is not the aim; as much flesh is left adhering to them as will soon dry, and the ligaments are wanted to keep the bones attached to one another. If cleaning were too thorough in the field, many of the bones might drop off before the skeleton were safely home.

First remove the skin roughly, without including in it any of the bones. In most cases, this skin should be labeled to correspond with the bones from the same individual, and kept; it will be of great value in assuring the specific identification. Disembowel the bird, taking care not to cut the breast bone, ribs, or the small bones near the vent. Detach the legs from the body at the hip-joint and remove the flesh, taking care not to remove the knee-cap.

The flesh may be removed from the wings without separating them from the shoulder; but great care must be taken in removing the large wing-quills not to lose the small bones of the wing tip, especially the one in the alula or bastard wing. From this indeed the feathers need not be removed, and the outermost three wing feathers may likewise be left untouched.

Other parts requiring special attention are the ploughshare-bone at the base of the tail-quills, the slender points on the under side of the neck vertebræ, and those projecting back from the ribs. It frequently happens that many of the tendons become ossified, as they do in the leg of a turkey. Look out for such on the under side of the neck, in the legs and wings, and along the sides of the back, and do not tear off the muscles as you would if preparing a skin.

Considerable flesh may be left on the neck and back, for it will dry easily, but the large breast muscles are to be cut away. The hyoid arch, or bones supporting the tongue and attached to the windpipe, should be saved, as should also the

windpipe itself whenever, as in many ducks, it has bony structures developed in part of its length.

The whole neck is kept attached to the body skeleton, and it is carefully separated from the base of the skull, without cutting any bones. The brain of small birds need not be removed, in larger ones it is taken out cautiously, with a loop of wire inserted through the hole by which the spinal column comes out of the skull.

In many birds, and especially in birds of prey, there is a ring of bones surrounding the pupil of the eye. They are not very visible, being enclosed in the front wall of the eyeball. It is therefore best not to remove the eyeball, but simply to puncture it to allow the escape of its fluid contents.

Cormorants have a small bone attached to the back of the skull; other birds have projections of bone at the hinder angle of the lower jaw; and some diving birds have elongate processes at the elbow or knee. So it is a good rule not to trim up a bird's skull, or even its limbs, too closely.

Fold up the legs, and place them, with the skull, inside the chest cavity. Do the same with the wings or fold them alongside the body, thus making a bundle which is held together by a few strings till dry. It may be hung up in the meantime by a string attached to the neck; and a thin piece of wood, tied securely to one of the larger bones (the coracoid, for instance, as in Fig. 25), should bear a catalog number, written with a very black lead pencil.

The data to be entered in the catalog are much the same as those for a skin: Sex (determined by dissection when disemboweling the specimen), locality, and date.

To avoid all difficulties with beetles (*Dermestes*, etc.) which swarm upon dried bones in all tropical countries, dip the whole skeleton, as soon as it is thoroughly dried, into a weak solution (of merely milky tint) of arsenical soap, and hang it up again to dry. If the beetles are allowed to eat away the flesh, many of the smaller bones may be separated,

and are almost certain to be lost. For added protection the dried skeleton may be sewn in a piece of cotton cloth.

Unless there are special reasons to be considered to the contrary, the first specimens of any species will always be preserved as skins. Afterwards, if the skeleton is believed to

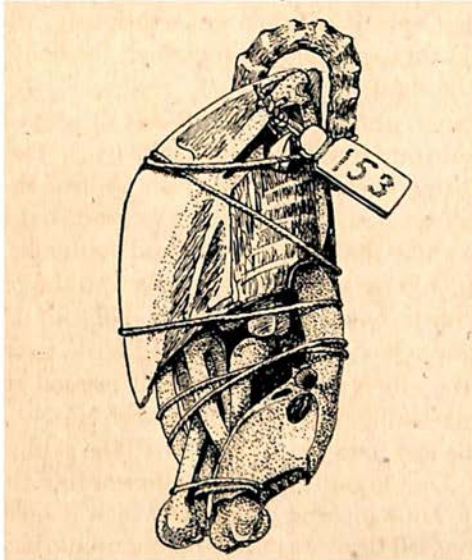
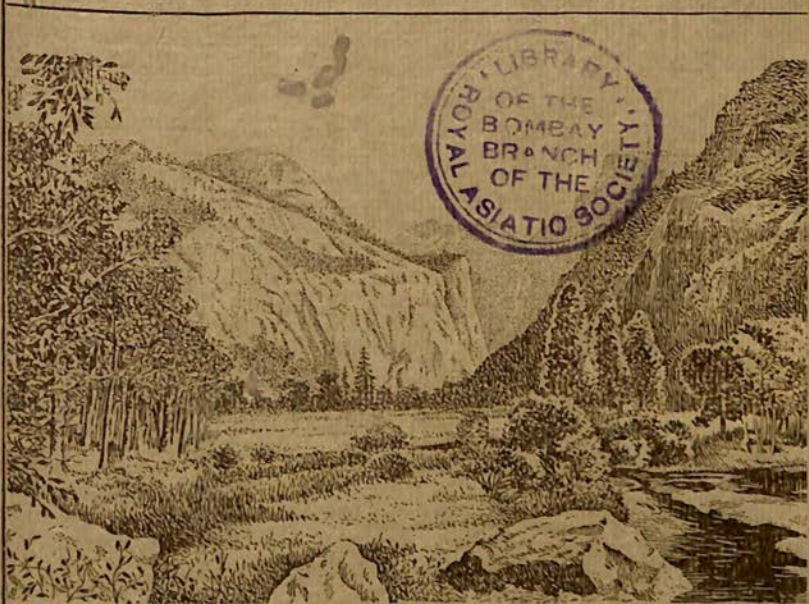


Fig. 25. Rough skeleton of a francolin, dried and bundled together for packing. The tag is of thin wood, bearing a number written with soft lead pencil.

offer points of interest, a few adult specimens, which have not many of their bones injured, may be prepared as skeletons. It has already been explained, however, that small birds, even though desired for their skeletons, are best sent home preserved in alcohol or formalin. Such specimens are also of great value for the study of the soft anatomy, and of the arrangement of feather tracts.

9
pht 3
THE AMERICAN MUSEUM OF NATURAL HISTORY

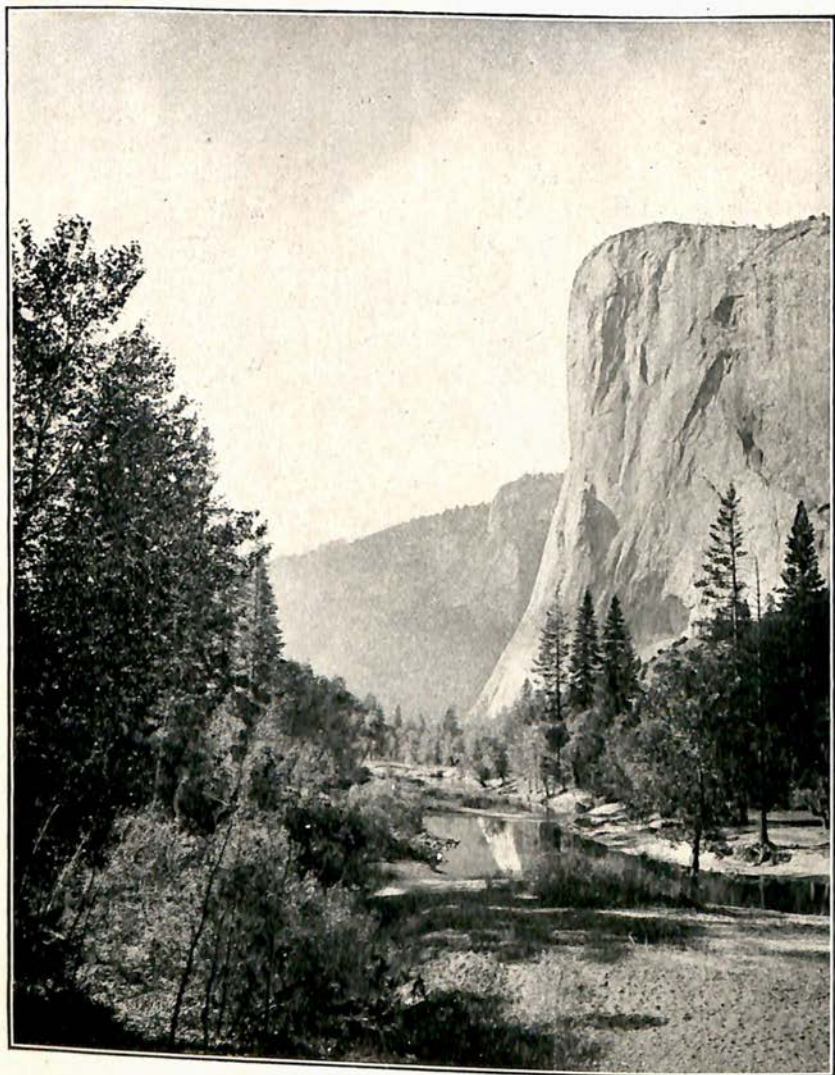
THE STORY OF THE YOSEMITE VALLEY



By FRANÇOIS E. MATTHES, Ph. D.

GUIDE LEAFLET No. 60





J. K. Hillers Photo

EL CAPITAN, THE NOBLEST CLIFF IN YOSEMITE VALLEY

The view shows the bold profile of the 3,000-foot cliff as it appears from the east at a distance of one and a half miles. Beyond El Capitan are the lesser cliffs that flank the recess of the Ribbon Falls.

THE STORY OF THE YOSEMITE VALLEY

By FRANÇOIS E. MATTHES, Ph. D.



American Museum of Natural History
Guide Leaflet No. 60
New York, July, 1924

The model of the Yosemite Valley and vicinity is one of a series of fifteen relief models of geologically important areas of the United States, representing the existing topography surface of the areas chosen. The hard-rock or underlying geology is represented by colors and patterns taken from the rocks themselves, except in the Watkins Glen-Seneca Lake and the Niagara Falls models, where the superficial Glacial deposits are shown, and in the Porto Rico model, where the scale of the map is too small to permit such treatment. The painted background of each model represents the present day scenery of the surrounding country, and the sky depicts different meteorological conditions as far as practicable.

With the exception of the Yosemite Valley and the Mount Washington models the subjects of these models and their location in the hall were suggested by Associate Curator C. A. Reeds. The construction of all the models has been done under the direction of Curator E. O. Hovey, except that the core of the Grand Canyon model was begun by Doctor Reeds. The cores of the models have been built at the Museum and have been based on the topographic sheets issued by the United States Geological Survey, and the United States Coast and Geodetic Survey, except for Porto Rico, based upon a compilation by C. A. Reeds, and Mount Washington, based upon the maps by the State of New Hampshire and the Appalachian Mountain Club. The modeling and painting have been done by Lester Morgan of Morgan Brothers, following published geological maps of the regions and photographs from several sources. In the Yosemite Valley model the geology has been represented according to unpublished maps and other data furnished by the U. S. Geological Survey.

THE STORY OF THE YOSEMITE VALLEY¹

BY FRANÇOIS E. MATTHES, PH.D.

UNITED STATES GEOLOGICAL SURVEY

If you should start from San Francisco in an airplane and fly due east you would pass first over the wooded crests of the Coast Ranges; next over the broad, level expanse of the Great Valley of California, checkered with irrigated fields, vineyards, and orchards; and then, after a flight of about a hundred miles, you would come to a huge mountain barrier, stretching north and south at right angles to your course and rising in a long, gradual slope to a resplendent row of snow-flecked peaks. This is the Sierra Nevada, the longest, the highest, and the grandest single mountain range in the United States.

Deeply carved in its western flank, about midway between the torrid foothills and the wintry summits, in the genial middle zone of majestic forests, you would discover the Yosemite Valley, the chasm that has become renowned the world over for its towering cliffs, its stately trees, and its delightful climate, but, above all, for its sublime waterfalls. If "Yellowstone" spells "geysers," "Yosemite" spells "waterfalls."

As you fly over the valley you may at first be surprised to find that it is no larger. It measures only 7 miles in length and 1 mile in width and is really but a widened part of a narrow canyon that furrows the range from crest to base,—the canyon of Merced River. Indeed, the valley is only one of a great many features—though by far the most wonderful—of the Yosemite National Park, which embraces a part of the western flank of the

¹Guide Leaflet No. 59 of the American Museum series.—Text kindly furnished through the courtesy of the United States Geological Survey.

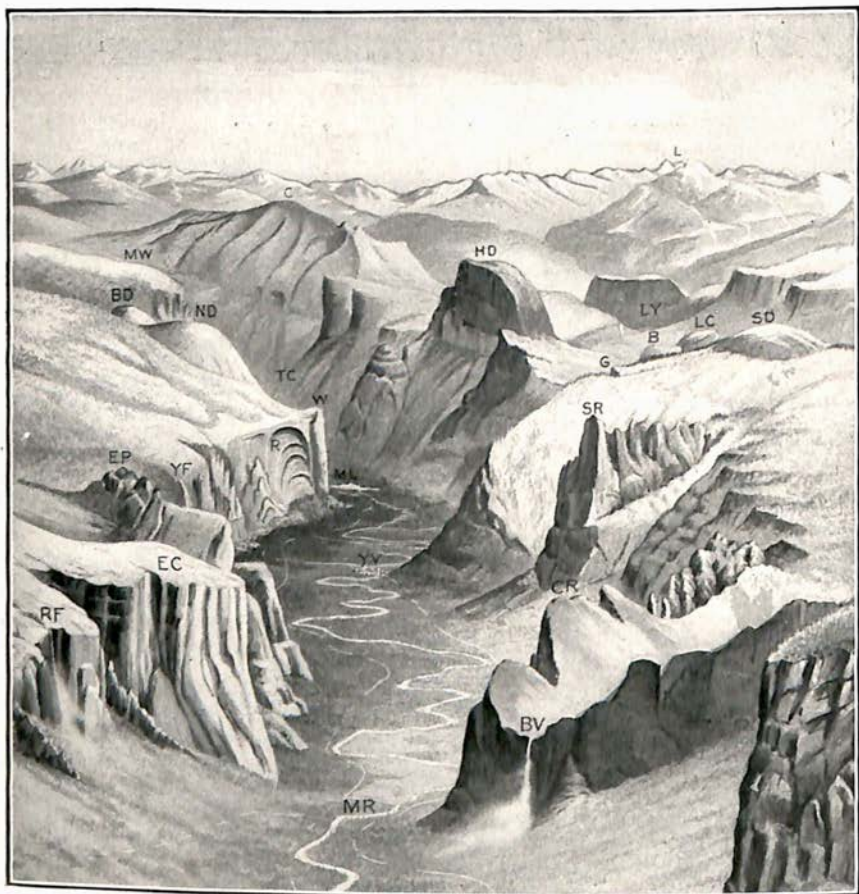


FIG. 1. BIRD'S EYE VIEW OF YOSEMITE VALLEY AND THE HIGH SIERRA BEYOND.

- | | | |
|----------------------|----------------------|------------------------|
| R F Ribbon Falls. | N D North Dome. | B Mount Broderick. |
| E C El Capitan. | B D Basket Dome. | G Glacier Point. |
| E P Eagle Peak. | M W Mount Watkins. | S D Sentinel Dome. |
| Y F Yosemite Falls. | C Clouds Rest. | S R Sentinel Rock. |
| R Royal Arches. | H D Half Dome. | C R Cathedral Rocks. |
| W Washington Column. | L Mount Lyell. | B V Bridal Veil Falls. |
| M Mirror Lake. | L Y Little Yosemite. | Y V Yosemite Village. |
| T C Tenaya Canyon. | L C Liberty Cap. | M R Merced River. |

Sierra Nevada almost as large as the State of Rhode Island, that is studded with peaks, domes, and spires and sculptured by valleys, gorges, and canyons. Among the canyons is the Grand Canyon of Tuolumne River, which lies 12 miles north of the Merced Canyon and parallel to it and which also has a Yosemite-like widened part—the beautiful Hetch Hetchy Valley.

But when finally you descend into the Yosemite you at once perceive the reason for its world-wide fame. No other valley is so remarkably fashioned; no other valley holds within so small a compass so astounding a wealth of striking and distinctive scenic features. As a whole, it is a broad rock-hewn trough with parallel sides, boldly sculptured and ornamented with silvery cataracts. The level floor, whose groves and meadows afford ideal places for camping and other forms of recreation, lies 4,000 feet above the sea, and the forested uplands on either side rise 3,000 to 4,000 feet higher.

As you look eastward up the valley from its lower end your eye is at once attracted by the sheer profile of El Capitan, the most majestic cliff in the Yosemite and perhaps in the world. It projects from the north wall, its top fully 3,000 feet above the valley floor. Directly opposite stand the three Cathedral Rocks, of nearly equal height, which form the only promontory that juts far out into the valley. From the west end of this promontory leaps the Bridal-Veil Falls, 620 feet in height, its spray suffused with the glory of the rainbow.

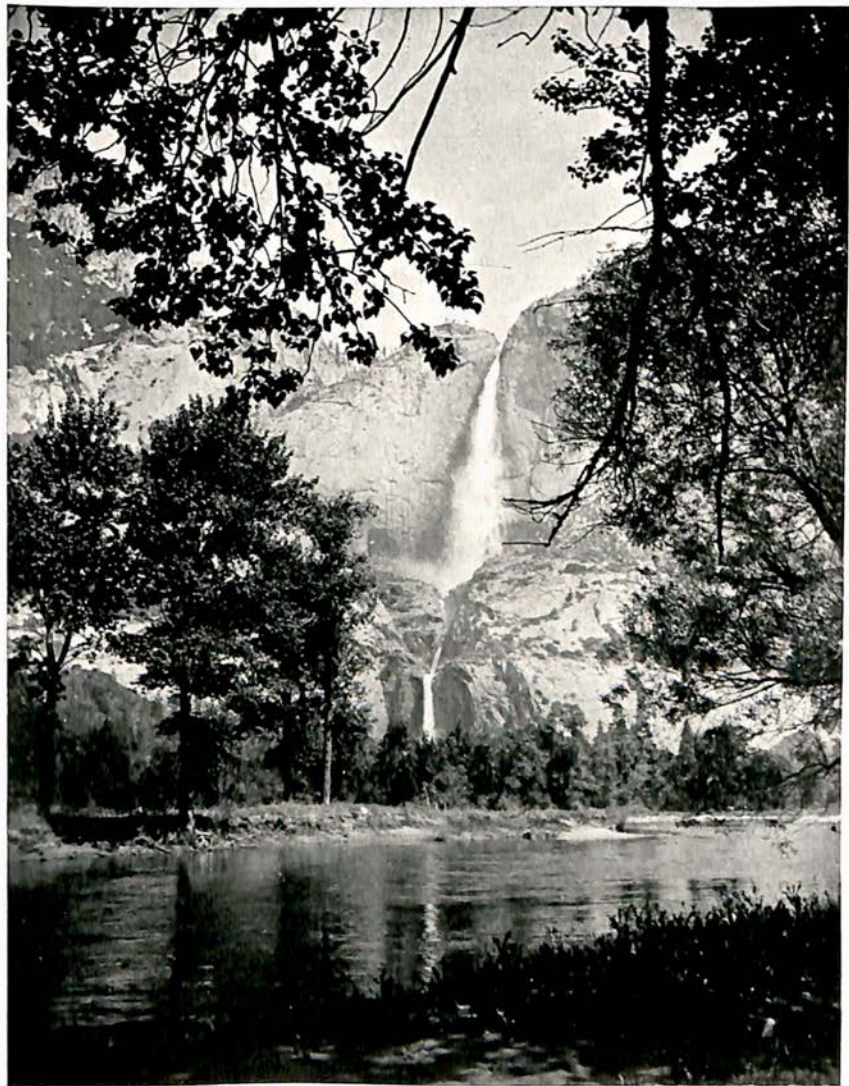
Eastward beyond El Capitan and the Cathedral Rocks the valley abruptly regains its full width, and you behold in an embayment on the right the two Cathedral Spires, the frailest rock shafts in the valley. On the left are the Three Brothers, whose gabled summits rise one above another, all built on the same angle, as if designed

by an architect. The highest, known as Eagle Peak, rises 3,800 feet above the valley. Opposite them stands Sentinel Rock, a finely modeled obelisk with a pointed top.



BRIDAL VEIL FALLS
620 feet high

A mile beyond the base of Sentinel Rock nestles Yosemite Village, the main tourist center of the park, and just across the valley, booming amid clouds of pearly



F. E. Matthes, Photo

YOSEMITE FALLS, FROM THE BANKS OF MERCED RIVER

The upper fall, 1,430 feet in height, is probably the highest fall of its kind in the world. The lower fall is 320 feet high, and the total descent of the water from the brink of the upland to the floor of the valley is 2,565 feet. The lower fall as seen above is three-fourths of a mile from the camera; the upper fall is nearly one and a half miles distant.

mist, are the Yosemite Falls, most glorious of all the cataracts in the valley. The upper fall, 1,430 feet high, would alone make any valley famous—it is the highest unbroken leap of water on the continent, perhaps the highest in the world. The lower fall, which descends 320 feet, seems insignificant in comparison, yet it is twice as high as Niagara. The entire chain of falls and cascades has a height of 2,565 feet.

Farther up, on the north side, are the Royal Arches, sculptured one within another in an inclined rock wall that rises to a height of 1,500 feet. An enormous natural pillar, the Washington Column, flanks them on the right, and above them rises a smoothly curving, helmet-shaped boss of granite called North Dome.

Facing the Royal Arches, on the south side, is Glacier Point, a high promontory that has become a veritable Mecca for tourists by reason of its matchless view and its unique overhanging rock, below which the cliffs fall off sheer 3,200 feet.

The head of the valley is squared off by another rock wall, and above that wall, planted as on a pedestal, stands Half Dome, the most colossal and most strangely modeled rock monument in the Sierra Nevada, smoothly rounded on three sides and cut down sheer on the fourth, like an apple sliced in two. Though it has been inaccessible heretofore, owing to the smoothness of its sides, it may now be easily scaled with the aid of steel cables so hung as to serve as hand rails.

From the summit of Half Dome, 4,850 feet above the valley, you look down, on the south side, into the Little Yosemite, a broad-floored, cliff-girt valley shaped like the Yosemite, though much smaller. It lies at a level 2,000 feet above the main valley, and from its portal, guarded by Liberty Cap, the Merced descends by a cyclopean stairway, making two magnificent cataracts,

the Nevada Falls, 594 feet high, and the Vernal Falls, 317 feet high.

On the north side of Half Dome you look down into Tenaya Canyon, a chasm as profound as the Yosemite itself, yet the pathway of only a small tributary brook. Almost directly under Half Dome, at the canyon's mouth, lies romantic Mirror Lake. To the northeast Clouds Rest, the loftiest summit in the vicinity of the valley, rises 9,929 feet above the sea, and beyond spreads the vast panorama of the High Sierra, its jagged peaks culminating in ice-covered Mount Lyell, at a height of 13,090 feet.

And now, filled with wonder at the marvels of this stupendous scene, you may feel impelled to ask: How was all this created? By what strange forces has the Yosemite been fashioned, and through what happy circumstances has it become endowed with so much charm and grandeur?

This, then, is the story of the Yosemite: Millions of years ago—about at the end of what geologists call the Cretaceous period—all the country reaching from the Pacific coast to the Rocky Mountains began to bulge up as a result of disturbances in the interior of the earth. The movement was slow and intermittent, yet it caused the crust of the earth to be rent by long fractures, or "faults," as they are called by geologists, and broke it into huge blocks that crowded against and slipped on one another. Some of these blocks were gradually forced up and more or less tilted, so that they began to stand out as mountain ranges; other blocks remained low or were depressed and formed valleys and basins. Thus originated the multitude of roughly parallel northward and northwestward trending ranges and intermediate desert basins of western Utah, Nevada, and eastern California.

The westernmost and largest block, 400 miles long and 80 miles broad, was destined to become the Sierra Nevada. It early acquired a feeble slant to the west, its eastern edge being pushed up and its western edge

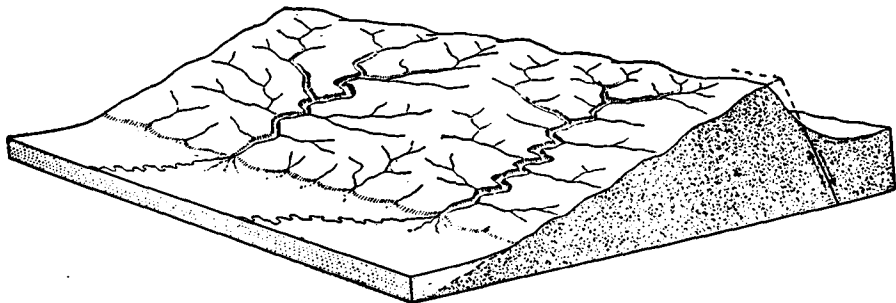


FIG. 2 GENERALIZED DIAGRAM OF A PART OF THE TILTED SIERRA BLOCK

The break, or "fault," that separated it from the next block to the east is shown by a heavy line, and the directions in which the blocks have slipped past each other are shown by arrows. The height and slant of the Sierra block are much exaggerated. In front of the range is a strip of the Great Valley of California, which is underlain by many layers of sand and silt washed down by streams. At the back of the range is a strip of Owens Valley, likewise covered with sediment. The main rivers on the Sierra block have arranged themselves roughly parallel to one another, in the direction of the western slopes, but their lesser tributaries continue to be guided by the irregularities on the surface and flow in diverse directions. The main rivers, having been accelerated by the tilting, have carved deep canyons, but many of their tributaries, and especially those that flow at right angles to the direction of the tilting, have not yet intrenched themselves and still drop into the canyons from "hanging valleys." The conditions shown correspond in a general way to those that prevailed for some time after the first great uplift mentioned in the text.

pulled down. After a great lapse of time—in the latter half of the Tertiary period—the slant of the block was steepened and the eastern edge was raised to a mountain crest several thousand feet high. Still later, about the dawn of the Quaternary period—the last great

division of geologic time, which embraced the Ice Age and witnessed the rise of man—a series of thrusts more vigorous than any that had preceded it tilted the Sierra block still more strongly and lifted it to its present great height—to altitudes ranging from 7,000 feet at the north to more than 14,000 feet at the south.

One effect of the tilting was, naturally, to bring about a rearrangement of the waters on the surface of the

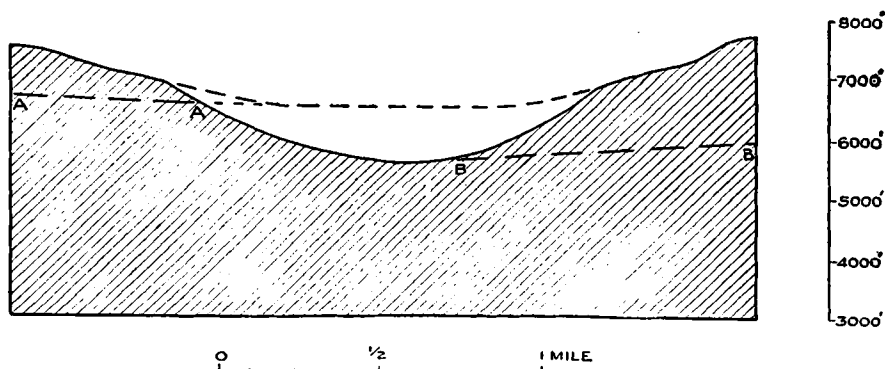


FIG. 3. SECTION OF THE "TWO-STORY VALLEY" WHICH THE MERCED HAD CUT BY THE END OF THE TERTIARY PERIOD.

A-A is the profile of a side stream which was unable to trench as rapidly as the Merced and whose valley has therefore remained "hanging." B-B is the profile of a side stream that succeeded in "catching up" with the trenching of the river. This diagram and the two following are drawn to scale and represent the successive stages in the development of the Yosemite Valley in their true proportions.

Sierra block. The main streams originally flowed in diverse directions, but when, early in the Tertiary period, the Sierra block acquired a considerable slant, they changed their courses and began to flow in the direction of the slant. A series of parallel rivers thus came into existence, all heading at the eastern edge and draining westward, into the Pacific Ocean. The Merced was one of these new rivers.

In the long period of quiet that followed the earlier tiltings the Merced fashioned for itself a broad, level valley, through which it wound sluggishly in serpentine meanders. The valley was flanked as far up as the site of the present Yosemite chasm by rolling hills and occasional ridges a few hundred to a thousand feet in height, all covered with luxuriant semitropical vegetation. The rounded summit of El Capitan was one of the rolling

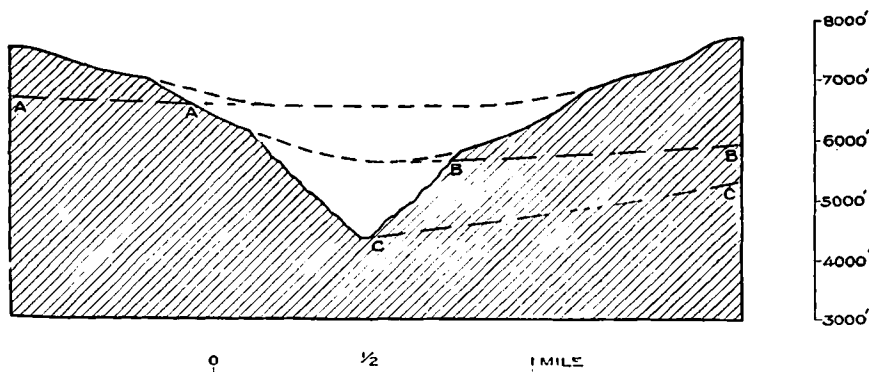


FIG. 4. SECTION OF THE "THREE-STORY CANYON" WHICH THE MERCED OCCUPIED EARLY IN THE QUATERNARY PERIOD, JUST BEFORE THE ONCOMING OF THE ICE AGE.

The river has cut its inner gorges so rapidly that now the valley of the stream B-B also is left "hanging." But a third stream C-C, more favored than the others because the rock in its path is unresistant, has succeeded in keeping pace with the trenching of the river.

hills; it rose about 900 feet above the Merced. Toward the headwaters of the river the land was more mountainous, but the region as a whole still lay near sea level.

The great uplift of late Tertiary time, which raised the Sierra block to a height of several thousand feet, affected the behavior of the Merced profoundly. The course of the stream now being much steeper than before, its flow became swift and powerful, and, with the sand,

gravel, and boulders that it swept along, it began vigorously to scour and deepen its bed. As time went on it cut in the broad floor of its old valley a narrow, steep-walled gorge—a “gorge within a valley.” Although it cut ever more and more slowly as its gradient became flatter and flatter, toward the end of the Tertiary period

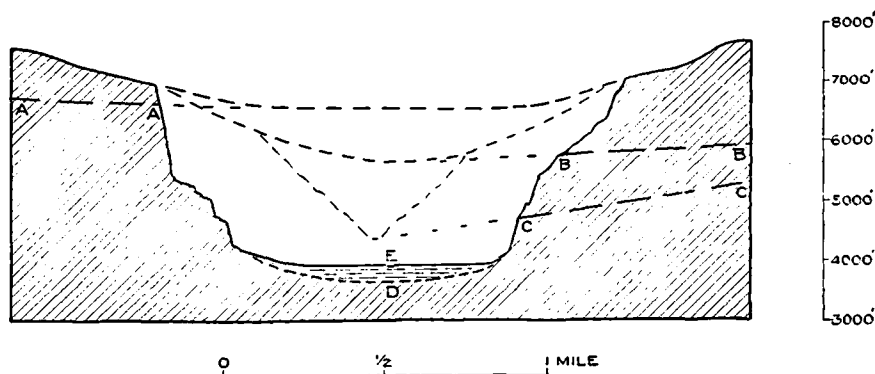
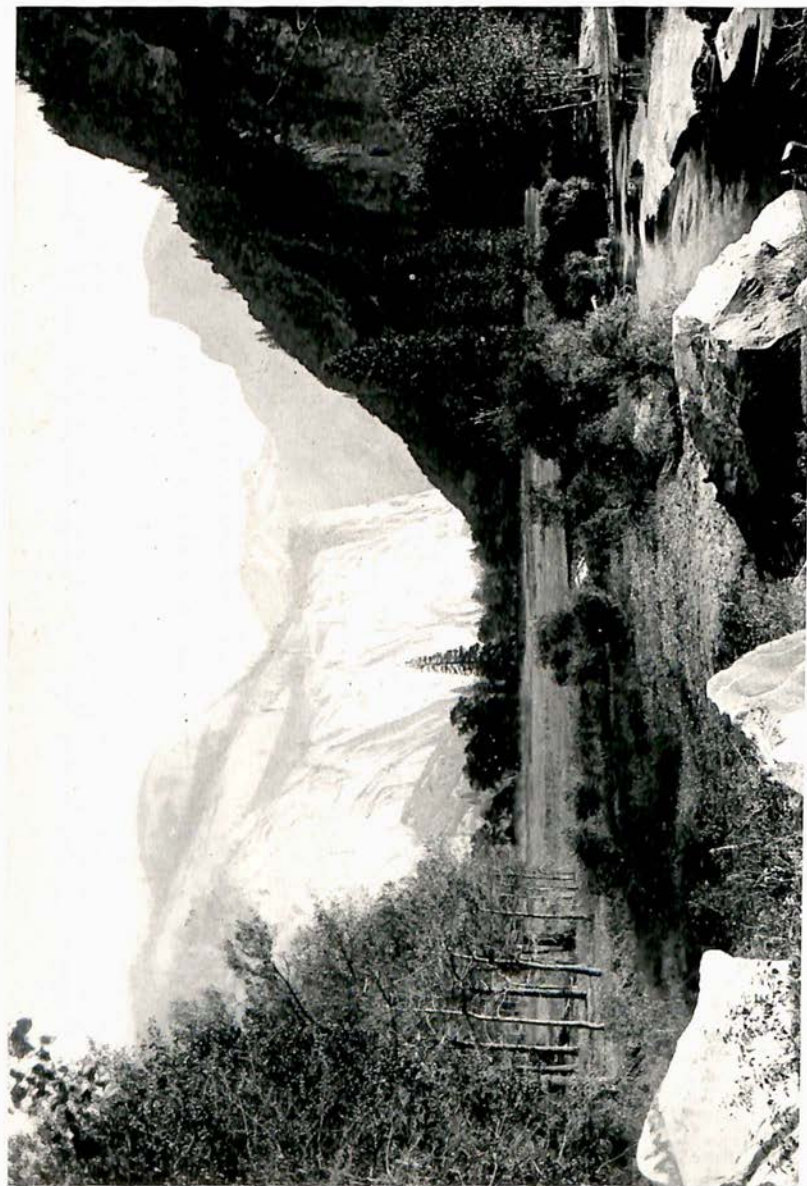


FIG. 5. SECTION OF THE BROAD, STEEP-SIDED YOSEMITE TROUGH AS IT IS TO-DAY.

The transformation from the original “three-story canyon” was accomplished mainly by the quarrying action of the glaciers of the Ice Age. The floor of the glacial trough is at D. The present valley floor is at E, and D-E is the depth of the basin of ancient Lake Yosemite, which now is filled with river-borne sediment. As a result of further deepening of the chasm and of its widening by the ice the valley of the stream C-C now also “hangs,” so that there are three sets of “hanging valleys” at different levels, one above another, all having waterfalls pouring from their mouths.

the river had intrenched itself nearly a thousand feet. The gorge, however, had been transformed by that time, through the crumbling of its walls, into a valley with sloping sides, and so the river lay at the bottom of a “valley within a valley”—or a “two-story valley”—such as is outlined in Figure 3.



J. K. Hillers, Photo

YOSEMITE VALLEY, FROM THE FOOT OF THE THREE BROTHERS

The side streams were at first unable to trench as rapidly as the Merced. They had smaller volume and therefore less cutting power, and a number of them were handicapped by following courses that lay at right angles to the general course of the river and therefore at right angles to the slope of the Sierra block. These streams were not steepened by the tilting and continued to flow as leisurely as before. As the river cut its gorge deeper and deeper, therefore, the side valleys remained "hanging" at greater and greater heights. They were transformed into what are properly termed "hanging valleys." But later, as the master stream's gradient became flatter and its cutting power waned, most of the side streams by degrees "caught up" with its trenching and the hanging valleys were destroyed—all but a few in the Yosemite region that were underlain by exceedingly resistant, massive granite. These few remained almost untouched and so, at the end of the Tertiary period, the Yosemite was left with several hanging side valleys from whose lips foaming cascades poured. Yosemite Creek, which now produces the great Yosemite Falls, then made a broken cascade 600 feet high. Bridal Veil Creek and Sentinel Creek each cascaded down a vertical distance of 900 feet; Meadow Brook 1,200 feet; Ribbon Creek 1,400 feet.

The last and greatest uplift of the Sierra Nevada, which occurred about the beginning of the Quaternary period, again accelerated the Merced to the swiftness of a mountain torrent—indeed, it gave that stream greater velocity and cutting power than it had ever possessed. What is more, the greatly increased height of the range brought with it a marked change in climate. Deep snows fell on the crest in winter, and the rapid melting of these snows in spring produced freshets of tremendous volume and correspondingly great destruc-

tive power. Thus the river again intrenched itself and with greater rapidity than before carved a new inner gorge, thus producing a "three-story canyon" such as is outlined in Figure 4. In this new inner gorge the river still flows from the lower end of the Yosemite to the foothills. At El Portal, the main gate to the Yosemite National Park, the gorge attains its greatest depth—about 2,000 feet—and the three-story canyon as a whole has a depth of about 3,500 feet.

As happened after the preceding uplift, so after the last, the side streams, and especially those running at right angles to the direction of the tilting, were unable to trench as rapidly as the master stream. And so the new gorge came to have a number of hanging side valleys, and the Yosemite, which already possessed one set of hanging valleys, acquired a second, lower set. To this lower set belong the valleys of Indian Creek and Illilouette Creek. Both of them, as well as some of the hanging side valleys of the lower Merced Canyon, are to-day still well preserved, although they are underlain by less resistant rocks than the older and higher hanging valleys of the Yosemite region. Indeed, so short a period of time, in a geologic sense, has elapsed since the last uplift that only a few of the larger and more favorably situated side streams have succeeded thus far in "catching up" with the trenching of the master stream.

Among these more successful streams are two tributaries of the Yosemite Valley—Tenaya Creek and Bridal Veil Creek. Tenaya Creek had the double advantage of a southwesterly course, following the direction of the tilting, and of being underlain by closely fractured rock and was thus able to trench deeply. Bridal Veil Creek, less advantageously situated, carved only a short, steeply descending gulch—the gulch that now ends abruptly at the precipice of the Bridal Veil Fall. That

cataract, however, was not yet in existence, for the gulch led directly to the bottom of the main chasm. The present lip of the gulch at the top of the waterfall, it is believed, still indicates roughly the level at which the Merced lay in early Quaternary time—that is, just prior to the first great extension of the glaciers of the Ice Age. Evidently the Yosemite then already had a depth of 2,400 feet, measured from the brow of El Capitan. It was, however, a much narrower and less impressive chasm than the Yosemite of to-day; it was a “three-story canyon” no wider at bottom than the channel of the river itself and winding sharply among craggy spurs that projected alternately from either side. But it was adorned by cascades of remarkable height: Illilouette Creek cascaded down 600 feet; Indian Creek 1,500 feet; Yosemite Creek 1,900 feet; Meadow Brook 2,300 feet; Sentinel Creek and Ribbon Creek each 2,400 feet.

And now came that epoch of cold climate which brought on the great Ice Age. Snow gathered to depths of hundreds and finally thousands of feet in the upper valleys of the range and, becoming compacted to granular ice, formed glaciers that slowly crept down the canyons, moving a few inches to a few feet each day. Small remnants of these ice streams remain to-day on the shaded sides of the highest Sierra peaks, notably on Mount Lyell and its neighbors. Two great glaciers advanced, each more than 2,000 feet thick, one through the Little Yosemite, the other through Tenaya Canyon, and, joining at the head of the Yosemite, formed a mighty trunk glacier that filled the chasm to the brim and extended ten miles down the Merced Canyon.

For hundreds of centuries this glacier held sway, quarrying and scouring the rocky sides and floor of the chasm with tremendous force, due to its weight and its

irresistible forward movement. It excavated the chasm 600 feet more at the lower end and 1,200 feet more at the upper end. It cut off the projecting spurs and wiped the inner gorge out of existence. Then the climate grew milder, the glacier by degrees melted back to its sources on the crest of the range, and for an interval that doubtless also lasted hundreds of centuries the river resumed its work. At the end of this interval the glacial climate returned and the Yosemite again fell under the dominion of the ice. But this time the glacier was much shorter and thinner; it reached no farther than the Bridal Veil Meadow and filled the valley only one-third of its depth. Moreover, the glacier was relatively short lived, and it therefore accomplished much less excavating than its mighty predecessor, whose work, however, it accentuated.

And so, when at length the Ice Age came to a close the narrow three-story canyon had been transformed into a broad U-shaped trough; the craggy slopes had been quarried back to vertical cliffs, and the broken cascades replaced by leaping falls. (See Fig. 4.) Moreover, three new falls of this kind had been created, for in deepening the chasm the glacier had left the gulch of Bridal Veil Creek hanging, thereby causing that stream to leap over a vertical precipice 620 feet high; and in its descent from the Little Yosemite the glacier had hewn a giant stairway down whose steps the Merced now makes two successive leaps, in Nevada and Vernal falls. Finally, a basin had been scooped out in the rock floor of the valley, and in this basin was formed a lake five and a half miles long—ancient Lake Yosemite. Similar but smaller and shallower lake basins were scooped out in the Little Yosemite and in Tenaya Canyon.

The ice was greatly aided in making these prodigious changes in the configuration of the Yosemite Valley by



F. E. Matthes, Photo

THE HALF DOME
From the trail beneath Glacier Point

the numerous cracks, or "joints," as they are properly termed, that divide the granite into natural blocks and made it easy to quarry away. In Tenaya Canyon also the glacial quarrying was facilitated by joints, but in the Little Yosemite, which is underlain by extremely massive, undivided granite, the ice could only rasp and polish, and therefore the Little Yosemite, which is the path of the master stream, now lies, anomalously, 2,000 feet higher than Tenaya Canyon, which is the path of a feeble tributary. Below the Yosemite Valley also the granite was too solid to be quarried effectively by the ice and the inner gorge there has thus been preserved.

The great cliffs and domes of the Yosemite region are all made of essentially massive granite. El Capitan and the Cathedral Rocks project from the walls of the valley because they consist of enormous monoliths that have yielded but little to the onslaughts of the ice. Half Dome and the other domes rise high in the landscape because their unfractured masses have survived the destruction that has been wrought by ice and weather in the surrounding fractured rock. They owe their smoothly rounded forms not to the grinding of overriding glaciers—some have never been overridden—but to the bursting off of successive concentric layers, or "shells," from their surfaces as a result of exposure to the heat of the sun and the weather.

Since the Ice Age ended, about 20,000 years ago, only a few noteworthy changes have come over the aspect of the Yosemite region. The shallow lake basins in the Little Yosemite and Tenaya canyon were filled, little by little, by the forward-growing deltas which the streams built with their loads of sand and gravel. And then, Merced River and Tenaya Creek still being heavily loaded, the larger and deeper basin of Lake Yosemite was filled

by them in the same manner, and the level, park-like valley floor was created.

The cliffs have suffered from the destructive action of the elements, which has piled up at their feet great masses of rock waste. Huge rock avalanches, thrown down probably by earthquakes, have dammed Tenaya Canyon at its mouth, thereby impounding a new body of water—Mirror Lake—and other great rock slides in the lower half of the valley have formed long slopes that have permitted man to build wagon roads leading out to the uplands.

To-day the Merced is further deepening its canyon, the cliffs are being sculptured by frost and heat and rain, and almost imperceptible changes are everywhere going on, even on the face of El Capitan, which seemingly stands eternal, like the proverbial "Rock of Ages." The natural processes of destruction and creation are still day after day continuing their marvelous work, and thus we get glimpses of the way the Yosemite was made and is still in the making.



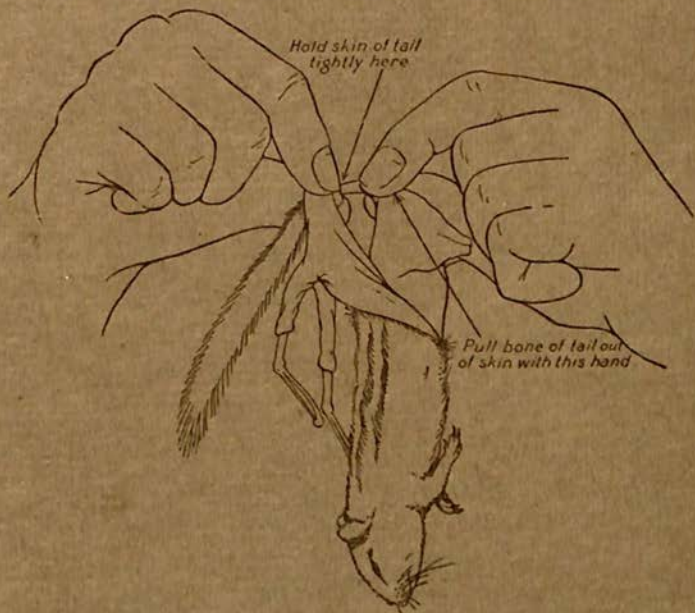
FOR THE PEOPLE

FOR EDUCATION

FOR SCIENCE

THE AMERICAN MUSEUM OF NATURAL HISTORY

The Capture and Preservation of Small Mammals for Study



By H. E. ANTHONY

GUIDE LEAFLET No. 61

NOTE

This leaflet is one of a series intended to furnish accurate information in regard to the preparation of specimens of various kinds for Museum purposes.

The following have been issued and may be purchased at the sales booth or from the Librarian; others are in the course of preparation;

**The Capture and Preservation of
Small Mammals for Study**

By H. E. Anthony. Price 15 cents

The Preparation of Birds for Study

By James P. Chapin. Price 15 cents

How to Collect and Preserve Insects

By Frank E. Lutz. Price 10 cents

The Preparation of Rough Skeletons

By Frederic A. Lucas. Price 10 cents

**Suggestions to Collectors of
Reptiles and Amphibians**

May be had on application to the Curator,
Department of Herpetology

**Brief Directions for Preparing Skins
of Large Mammals**

May be had on application to the Curator, of Mammals

THE CAPTURE AND PRESERVATION OF SMALL MAMMALS FOR STUDY

By H. E. ANTHONY

Associate Curator of Mammals of the Western Hemisphere



38555

The American Museum of Natural History
Guide Leaflet No. 61
New York, November, 1925



CONTENTS

	PAGE
Absorbent	9
Alcohol	11
Ammunition	12
Ants, Guarding Against	52
Aquatic Mammals, Capture of	17
Auxiliary Barrels	12
Baits	19
Bait, Combination	20
Bats, Collecting	47
Bats, External Characters of	51
Bats in Caves	48
Bats, Shooting	48
Bats, How to Skin	49
Care of Mammals after Shooting	14
Catalogue of Specimens	21
Collecting Chest	39
Containers for Dried Skins	42
Cornmeal	26
Cotton	8
Customs, Duties	53
Date	21
Field Catalogue	25
Filling Out the Skin of a Small Mammal	33
Formaldehyde	11
General Instructions for Capture of Small Mammals	12
Guns, Caliber of	12
Height of Ear	24
Hunting, Best Time for	12
Ink	11
Insecticide	10
Jacking	13
Labeling of Specimens	21
Labels	10
Length of Hind Foot	23
Length of Tail Vertebrae	23
Length, Total	22
Life-histories	51
Locality Where a Specimen Has Been Taken	21
Mammals Larger Than Woodchuck	45
Material to be Sent to American Museum of Natural History	53
Measuring of Specimens	21
Miscellaneous Data for Labels or Note-books	51
Miscellaneous Hints	50
Needles	9
Night Hunting	13
Old Mammal Skulls	47
Owl Pellets	47
Packing	42
Pads on the Feet	51
Pinning Out the Skin	38

Pins.....	9
Poisons.....	20
Preservation of Small Mammals Entire.....	43
Preservative.....	8
Runways.....	16
Scents.....	20
Sex.....	21
Short Cuts in Preparing Skins.....	50
Shot.....	12
Shot-gun.....	12
Skeletons.....	46
Skin, Greasy or Bloody.....	31
Skinning a Large Mammal.....	45
Skinning a Small Mammal.....	26
Skins Permanently Packed.....	42
Skull.....	38
Skull Labels.....	39
Skulls, Packing of.....	42
Small Skins, to Dry Out.....	39
Stomach Contents.....	51
Study Skin, What is a.....	5
Supplies Needed.....	8
Thread.....	9
Trap-lines.....	15
Trapping Small Mammals.....	15
Traps.....	18
Traps, Most Suitable Places for.....	16
Tools Needed.....	5
Tow.....	8
Wire.....	10

THE CAPTURE AND PRESERVATION OF SMALL MAMMALS FOR STUDY

By H. E. ANTHONY

The small mammals of any region are apt, with certain exceptions, to be less known than the large mammals. Small species which are active in the daytime, such as squirrels, are quickly noted and become familiar, but by far the greater number of small mammals are nocturnal in habit and hence escape observation unless special methods are adopted for their capture. The sportsman and large-game hunter acquaints himself in a short time with the appearance and habits of the large mammals of a region. He may spend years in a place without knowing by sight more than ten per cent. of its smaller mammal fauna.

As a consequence of this ability of the small mammals to escape notice, there is far less known about them than about the large, more or less spectacular mammals which the sportsman hunts for the pure love of the chase. Many of these game mammals range over extensive territory without becoming differentiated in any way or at the most differing only as subspecies. There is very little chance today for a large-game hunter to shoot a species new to science. On the other hand, there are very excellent opportunities for him to collect small mammals which have never before been taken, if only he will divert some of his attention to the mammals which he has been in the habit of considering beneath his notice. The shooting of a bear or lion is an achievement attained by thousands and often only a question of a moderate expense of time and money. These creatures were known to the ancients and the very nature of these animals demands that attention be paid them. There is no thrill of the chase, in the sense that one is risking his life, in the capture of some obscure, timid, and secretive small mammal, but if the species

is one that has never been known to Natural Science before, the discoverer should feel a satisfaction beyond that which attaches to ordinary trophies. It is distinctly worth while for the sportsman to spend some of his time and efforts upon the smaller mammals of the region he visits; especially is this true if he is hunting in some out-of-the-way corner of the globe, for the study skins he may bring back might be of far more value to Natural Science than the large animals which have always been filling the eyes of the sportsmen.

This is not intended as a dissertation against the scientific value of the large mammals,—far from it. Many of the large species are rapidly becoming extinct and if life-histories and intimate knowledge of these last survivors are to be obtained, surely no time must be lost. It is true, however, that a strong plea for the collecting of study skins exists, and men who go to great expense to reach new hunting fields could do a great service to museums, and to the knowledge of Natural Science, if they brought back with them as many of the small mammals as they could conveniently secure without interference with their plans for large game. Natives are often able to attend to the routine preparation of the material, or can be taught to do so, and the operation of a trap-line will not disturb the large mammals in any way.

This handbook has been written in response to a definite demand coming from two separate sources. Many of the sportsmen who plan trips to remote regions have made inquiry at this Museum as to what they might collect which would be of value for museum purposes. Their willingness to assist the aims of the Museum extends not only to the securing of the larger species for the exhibition halls, but also to a desire to be on the lookout for any mammals which have an especial interest or some particular bearing on any problem before the Museum. It may happen that the region under contemplation is the home of some much-desired small mammal and the offer of coöperation is decidedly welcome.

It is necessary then to instruct the sportsman in the methods of capture and preparation of small mammals.

The other class of naturalists for whom these pages are written is the man or boy who feels a definite calling to take up the study of wild life and who wants to know how to go about it. He may know something about removing the skin of a small mammal but he knows nothing about what constitutes museum methods and practice.

What is a Study Skin?

A well-equipped museum has, in addition to the mounted specimens of mammals on public exhibition, large series of specimens made up into what are called study skins. These series are necessary in order that the species may be studied to best advantage; that we may know whether the color of the animal varies with season, sex, or age, whether two mammals of similar external appearance really are the same in internal structure, etc., etc. It would be out of the question to attempt to care for the large collections brought together for this purpose by mounting them and placing the animals in the glass cases of the public halls. Study skins must be kept in storage cases that are light-tight, to prevent fading of color, and insect-proof; and the skins must be so prepared that many can be placed in one storage case. The method of making study skins strives to accomplish these two ends,—the preservation of all of the characters possessed by the animal when alive, and the production of a specimen which will be easy to store, protect and study. There is nothing in the preparation of a study skin which prevents the later mounting of the specimen for exhibition.

Tools Needed

Study skins of small mammals may be prepared with a small pocket-knife as the only tool, but skins may be made better and with less time if a few simple tools are secured.

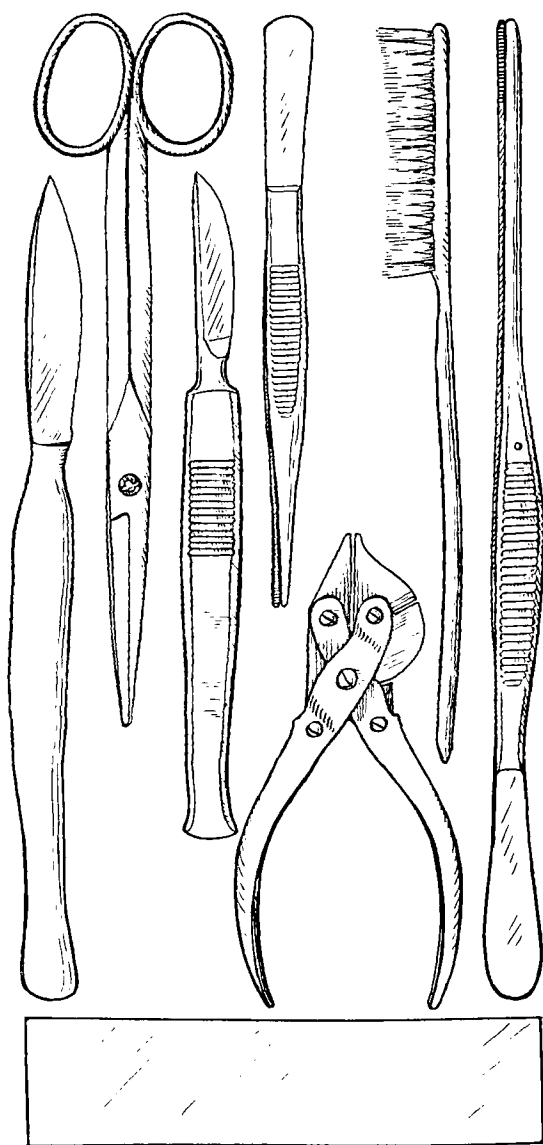


Fig. 1. Most important tools for making skins of small mammals.

The following will answer practically every purpose, but collectors develop individual methods and in time one might add several implements to this list.

- 1 steel tape, one or two meters long, marked in millimeters
- 1 steel ruler, about a foot long, marked in millimeters
- 1 small scalpel
- 1 large scalpel
- 1 pair of small, straight scissors
- 1 small pair of forceps or tweezers
- 1 large pair of forceps
- 1 tooth-brush
- 1 pair of pliers, with wire cutter
- 1 small carborundum oil stone

Additional tools that will probably be useful include extra scalpels, a larger skinning knife, a flat file, a steel comb, a larger pair of scissors, etc.

SUPPLIES NEEDED

Preservative

The skins of small mammals are best preserved by a mixture of arsenic and powdered alum (ammonium), the proportion about half and half by volume or by weight. Arsenic may be used without the alum but in a warm climate it is safer to employ alum to set the hair while the skin is drying. Do not use salt on a skin that is to be closed up, such as a chipmunk that is sewed up as a study skin. Sometimes when a collector runs out of arsenic he may make up his specimens without any preservative, and the skins will dry satisfactorily. They must be poisoned with the arsenic at the first opportunity, however, lest they be attacked by beetles (*Dermestes*) or moths, which may eat off all the hair.

A pound of arsenic mixed with a pound of alum will poison and preserve a great many small mammal skins, and five pounds of each powder will serve for quite an extensive expedition and for hundreds of small specimens.

The arsenic-alum mixture can be kept either in a flat, wide-mouthed tin (friction-top) or in a paraffin bag, made double by putting one bag into another.

Cotton and Tow

Cotton is employed as filling for small skins and may be secured in several grades. Tow, however, is the principal substance used for stuffing study skins, and if a fine, soft grade of tow can be purchased, the collector will seldom use his cotton. The tow should have long, soft fibers, and be free from lumps and dirt.

The very smallest skins need cotton, shrews, for example, being rather too tiny to fill with tow. For this purpose a fine grade of cotton, Dennison's best cotton, or jeweller's cotton, should be selected. One half-pound roll of this will last a long time for the average collecting.

The cheaper cotton is useful to pack around dried skins, since it comes in a rolled-up sheet that may be opened out to lie smooth and flat.

Five pounds of the ordinary cotton and five or ten pounds of tow will be all that is needed for several hundred small skins.

Absorbent

The best absorbent to use in skinning and cleaning skins is fine, dry cornmeal or fine sawdust. Used freely, cornmeal is such an aid to skinning that plenty of it should be kept on hand. It can be used over and over again, simply throwing away each time only the bloody portions, and is best kept in a waterproof bag, the mouth of which can be rolled down and kept open when in use.

Three to five pounds of cornmeal will last as long as the cotton and tow listed above.

Needles and Thread

A paper of assorted needles to take No. 25 and No. 50 or 60 linen thread will be needed.

A spool of each of the sizes of thread listed, preferably white, will be ample for sewing up the skins of several hundred mammals, but if thread is used for other purposes, such as on labels or wrapping up skeletons, more spools of the coarser size will be needed.

Pins

Ordinary white pins may be used for pinning out skins to dry, but experience will soon demonstrate that the black steel pins with the round glass heads are very much more satisfactory. The larger heads of the steel pins save the skin of the fingers and the hard points stick into the drying board better. At least five hundred steel pins will be needed for active collecting and a paper of the white pins will be useful for pinning paper about the dried specimens.

Labels

The American Museum of Natural History furnishes labels of standard pattern to its collectors. Such a label is shown in Figure 17. Lacking such a label, ordinary stringed tags such as Dennison makes may be used. Labels should be tied on firmly and a makeshift label that may be lost should not be used.

Wire

Wire in various sizes is needed for the tails of small mammals. A non-corrodible wire is much to be preferred and the American Museum has been using monel-metal wire with good success. The sizes needed are Nos. 16, 18, 20, 22, 24 and 26. Mammals needing wire heavier than No. 16 are seldom made up in the field. Only the smallest of mammals require a wire as small as No. 26. By far the greatest number of skins will be prepared with Nos. 18, 20 and 22.

The weights of wire needed will vary with the region where collecting is done. If many large squirrels, rabbits, etc., are wired, the larger sizes will be required and five pounds of wire will not last long. On the other hand, a pound of No. 22 wire will serve for a hundred or more of small mammals.

Insecticide

In addition to the use of arsenic on the flesh side of skins as a deterrant for insects, it may be necessary to put some insecticide in the box with the dried skins when they are shipped or to prevent ants from eating off the ears, toes and lips of skins that are drying. Various substances may be used for this purpose—Naphthalene being probably the best. California Insect Powder, Persian Insect Powder and Paradichlorbenzene (trade name, Paracide) may be used with success. The Paradichlorbenzene is especially effective but slowly evaporates if left out in the open; it is non-inflammable and non-explosive.

Alcohol and Formaldehyde

Alcohol is very useful for preserving specimens entire or for such soft parts of the anatomy as may be desired. The alcohol should be at least 85%. Avoid hardening the specimens by using the alcohol too strong, but beware of a weak solution in a hot climate.

Formaldehyde as obtained in a commercial solution generally runs about 40%. This solution may be diluted considerably. Take one part of formaldehyde by volume to from 10 to 15 parts of water, depending on the nature of the specimen, the climate, etc. Since formaldehyde hardens and contracts tissue, it is advisable to use it in a solution as dilute as will preserve from decomposition, and this may be as weak as a one to twenty solution under favorable circumstances.

Make certain that specimens are thoroughly immersed when placed in liquid; especially make sure that the fur is wet through.

Ink

India ink or water-proof carbon ink (Higgins' is an excellent brand) should be used for entering data on labels and in catalogues. Since the labels are comparatively small in size for the data that sometimes must be written on them, it will be found that a fine steel pen is best, because with it the letters may be kept small and entries legible. If the collector can print his data rather than write it, the label will be neater, but this, of course, is a refinement which adds nothing to the characters of the specimen itself.

The data on skull labels may be written in with pencil if a paper or card label is used. The writing must be heavy enough to insure its permanence.

GENERAL INSTRUCTIONS FOR THE CAPTURE OF SMALL MAMMALS

Most small mammals will be secured by trapping: a comparatively few will be shot.

Squirrels and rabbits will more often be shot than trapped. For shooting small mammals a double-barrelled shot-gun is best and a 16-gauge gun will answer all but the most unusual requirements. The right hand barrel should have a modified choke, the left should be full-choked. Auxiliary barrels, to be fitted inside of the 16-gauge bore, are very useful devices and do not add greatly to one's equipment. The auxiliary barrels now used by the American Museum are .32 caliber, using the old .32 extra long center-fire shell (to be obtained only on special order from the factory) and .410 caliber, using a paper shell which can be obtained without difficulty ready loaded. The length of the auxiliary barrels is about five to eight inches and the barrels may be carried in the pocket when not used in the gun.

For the 16-gauge shells, No. 6 shot is the best all-around size, but there will be use for No. 8 and No. 10 shot, as well as for No. 12—if bats are to be collected. Larger sizes of shot up to BB and buckshot will be required, of course, for general collecting. The small shells for the auxiliary barrels are most often loaded with No. 12 shot.

It would be impossible to give, in this handbook, complete instructions for the successful hunting of small mammals in each part of the country. Local conditions requirespecial methods and it is presumed that any one who is seriously using this manual has probably already had at least the average hunter's experience and will know how to hunt for squirrels, rabbits and such small game. Space may be taken for a few hints, however.

The best time for hunting is early in the morning, just after sunrise, and late in the afternoon until it is too dark to

shoot. Look for the mammals where it is known that they feed. A tree of ripe fruit, a corn-field, a patch of clover, all offer a promise if visited at the right time. Some mammals may be called up by squeaking with the lips against the back of the fingers.

Often mammals may be shot by hunting with a light at night which could never be taken by ordinary methods of daylight hunting. Night hunting or "jacking," as it is sometimes called, is against the law in most of the states of the Union, but this practice may be followed in other regions where it is the most efficient method for large as well as small species.

The best light for the purpose is an electric flashlight, so constructed that the reflector with the bulb may be pinned to the hat in front and the batteries carried in the pocket. A five-cell dry battery gives a very strong light and will last for many hours of continuous use. Used for two or three hours a night, a set of batteries may last for several weeks. Carbide lights made especially for jacking are on the market but are so cumbersome and inefficient as compared to an electric light that they should be used only as a last resort if the flashlight cannot be obtained.

The light is so fastened on the hat that when the gun is thrown up to the shoulder the beams of light follow the line of sight. Mammals are seen at night by the reflection from their eyes and it is seldom that the hunter sees more of the game than the two glowing spots. The color of these spots varies with the species of mammal and may be bluish for deer, reddish for cats, etc. The color of the eyes and the distance between them serve as identifying characters. Care must be taken to avoid accidents. The eyes of cattle, horses, and other domestic stock shine beautifully under the light and it is much better to be cautious at first than sorry afterward. Night hunting will never make the collector popular with the natives if he shoots first and learns afterward. The eyes of man do not reflect light, at least under normal circumstances.

It is not unusual for a hunter to fire at a star when shooting at night. The wind moves the leaves of a branch aside and the star seems to move as would the eye of an animal. A good test under such circumstances is to watch the supposed eye when the light is on it and after the light has been turned to one side. If the "eye" remains visible when the light is removed it is a "star" but if the "star" shines only when the light is on the spot it is an "eye." The eyes of many creatures shine at night and it will require some experience before the hunter is able to identify what he sees. The eyes of spiders, moths, and insects often shine and sparkle amazingly; owls and night-birds, such as the goatsuckers, have luminous eyes that are very misleading; lizards may reflect light from the eye, and alligators and crocodiles send back the rays of light.

It is advisable when hunting at night, especially when in an unknown region, to reconnoiter first by daylight and learn the terrain and the features of the topography. This not only helps to bring the hunter back to camp the same night, but serves to prevent shooting-up a native's barn-yard, and locates fruit trees where mammals are feeding, streams they may visit, etc.

Care of Mammals after Shooting

When a mammal is shot the specimen should be so cared for that no unnecessary bleeding takes place. A hunting coat with large pockets is suitable for specimens the size of a squirrel. Smaller mammals should be carried to camp and skinned there. Larger specimens, the transportation of which is troublesome, may be measured and skinned out roughly where they are shot. Details of the skinning which require time, such as skinning out the hands and feet, may be left until later. Wounds may be plugged with cotton and the bleeding checked. If the temperature is high and the specimen may spoil before it can be given the time to skin it out, the removal of the viscera is advisable. In some cases it may

be advisable to wash the body cavity with a weak solution of formaldehyde, or even to inject a specimen with this solution.

Trapping Small Mammals

Trapping of small mammals is not difficult in most temperate regions, but in some places, notably in tropical America, it is an art not easily acquired. A trap-line should contain as many traps as the collector can give his attention to, after the various duties of a day are taken into consideration. In the tropics, where traps must be visited soon after sunrise and specimens must be skinned out the same day they are caught, the trap-line should be neither too long nor too far removed from camp. Where high temperatures do not exist much greater latitude may be taken.

To get a complete representation of the small mammals of a region, a collector should run a line of traps in every definite life-association area. That is to say, traps should be set along streams and ponds for the aquatic species, at the foot of trees, on logs or on boughs for the arboreal mammals, in high grass and bushes for the meadow-loving forms, and in burrows and holes for the digging or subterranean creatures. A good plan to follow is to set out traps so that by following an arc of a circle the collector will place some of his traps in each one of the special situations the region affords. A trap-line that leads directly away in a straight line may capture just as much as one that curves back again toward camp, but the time element is more in favor of a line that can be inspected both on the way out and back into camp.

It is no easy task to set out a large number of traps and then locate them the next morning without loss of time. By following prominent features of the topography this task is simplified. Traps can be set along a trail or a stream in likely places, or along the crest of a ridge. It is a help to place small markers on the twigs or vegetation near the trap and to adopt a system which tells something of the position of the traps.

A tuft of cotton twisted about a twig or blade of grass will catch the eye and call attention to the trap. If nesting birds remove the cotton, short lengths of white string may be used. Single markers may be used on each trap except for the third, when two markers are set out. A bit of colored calico could be used on the fifth trap. When running the line, therefore, the collector knows he must find three traps for



Fig. 2. Showing trap set close to log.

each double marker and five for each colored one. This often saves time and avoids running the line back very far to find the lost trap.

If natives are troublesome and steal traps too conspicuously marked, as they often do, another method must be employed. Twigs broken and hanging down, a blaze or knife-cut on a tree trunk, an overturned stone, and many other expedients will suggest themselves.

Quite often the most suitable places for traps are obvious to the collector. Under fallen logs, in holes under rocks or at the

bases of trees, in runways through the vegetation, or at any place where it is apparent that shelter or food exists, traps may be placed with confidence.

In some regions traps placed carelessly at random can not fail of a good catch; elsewhere, under conditions that appear much more favorable, a line of 100 carefully placed traps may yield only two or three mammals. When setting out traps it is advisable to place the trap so that animals may trip it in passing if they are not interested in sampling the bait. By taking advantage of natural lines of cover this can generally be done, and the figure on page 16 shows a trap placed against a log so that any rat or mouse running along in the shelter of the log must trip the treadle in passing.

When a runway is discovered the trap may be placed directly in it, preferably across the runway, because there is less chance of the mammal being thrown clear by the spring. It may be necessary to remove some of the floor of the runway in order to bring the trap flush with the surface. Burrowing mammals may be difficult to catch because they fill the trap with earth. Pocket-gophers and moles are especially troublesome in this respect, but the collector learns by the failures and evolves a technique to avoid this. Traps of special types are made for gophers and for moles and are more effective than steel traps.

Some aquatic mammals seldom run on the land and are not easily caught in the water. By searching for places where these mammals must take to land, at a waterfall for example, traps may be placed in the paths they must follow and specimens are secured. Under normal circumstances, mammals may be counted on to do the obvious thing, and this should be taken into consideration in the placing of traps. If a mammal standing on the ground is unable to reach a bait, it is quite apt to climb up on the nearest object which allows it to reach the morsel. If a low obstacle is in its path, it steps over it, and a trap may be set where the foot

comes down. The trappers of furs have many such methods, and while most small mammals apparently are not suspicious of traps, there are occasions when the resourcefulness of the collector is taxed.

The small traps for rats and mice should always be tied down to prevent a captured animal from dragging the trap away. Steel traps always have a chain fastened to them for this purpose but it will be necessary to put a cord or a small wire on the wooden traps. About two feet of strong, hard cord can be tied into the staple which holds down the trigger.

The bait for the small traps should either be sprinkled sparingly over the treadle and in front of the trap in the case of a loose bait, such as rolled oats, or else be placed directly in the bait hole in the treadle if the combination bait is used.

Small steel traps are often set, unbaited, in a runway or burrow. If a bait is employed it may be dropped here and there about the trap and then a few leaves scattered on top, or it may be suspended over the leaf-covered trap so that the animal steps into the trap while reaching for the bait.

Traps

The traps required for the capture of small mammals are of two main types. The traps for rats and mice may be of the common spring and board pattern, such as the Out-O-Sight; and the traps for the larger mammals are preferably a selection of different sizes of steel traps, the Newhouse and the so-called "jump" trap. These traps are standard and can be obtained almost anywhere.

The small traps on the market come in two sizes, a mouse size and a rat size. The American Museum has found it necessary to use a small trap intermediate in size between these, but such a trap must be made to order. Secure the best-made trap to be found; a cheap trap will warp and break after a hard rain. The Out-O-Sight trap has given the best satisfaction of any used by the American Museum. These

traps with wooden bases may be placed in hot paraffine for a minute or two and then placed in a warm spot to drain. This makes them water-proof and adds nothing that is distasteful to the animals which will visit them.

For active trapping at least 100 of the mouse traps would be carried and 50 of the rat size. Since traps occasionally break or are lost, a greater number will be needed for collect-

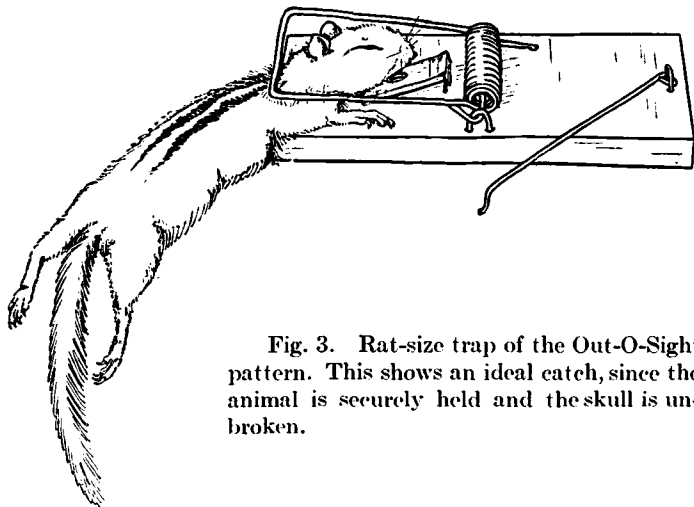


Fig. 3. Rat-size trap of the Out-O-Sight pattern. This shows an ideal catch, since the animal is securely held and the skull is unbroken.

ing extending over a long period. An average trap-line will mean about 100 traps out a night, more if mammals are difficult to secure, less if they are abundant. In some regions the proportion of rat to mouse size should be increased, or vice versa.

Baits

There are many baits which may be used successfully in trapping small mammals. Rolled oats is a standard bait for rodents. Bits of bacon, dried fruit, peanut-butter, cut-up vegetables or fresh fruit serve for rodents; and for the small

carnivores, scraps of fresh meat, bird bodies or carcasses from the skinning table may be attractive.

The most generally successful bait used by the American Museum collectors is a mixture or combination bait which I have worked out on the basis of field work in Ecuador. It is made as follows:

One part of bacon, cut up into small pieces; one part of cluster raisins, also cut up small; two parts of oily peanut-butter; rolled oats sufficient to make the mixture of putty-like consistency.

The bacon and raisins may be run through a food chopper if much of the bait is to be prepared. All of the ingredients should be thoroughly mixed and the final product will keep for months or years if stored in a tight jar or tin.

This combination bait is attractive not only to rodents but to shrews, opossums, and other small mammals. Unless carried away by ants, the bait lasts for several nights and is unaffected by light rains because of its oily nature.

No very signal success has been obtained by the use of special scents, such as asafoetida, fish-oil, etc., in trapping for smaller mammals.

Poisons

The use of poisons is not generally recommended for taking small mammals. The circumstances seldom arise to justify the use of poison and because of the uncertainty of finding the mammal after it has left the bait, it is a wasteful process. On open, exposed areas, poison is sometimes the best means of securing foxes and small carnivores.

MEASURING AND LABELING OF SPECIMENS

Each specimen should have tied to it a label with the following data:

1. The number given to the specimen by the collector.
2. Locality or place of capture.
3. Date.
4. Sex.
5. Measurements.
6. Name of Collector.

1. A catalogue of the specimens collected should be kept from day to day and a number assigned to each animal as it is skinned. This number is written not only in the catalogue but on the label which is tied to the skin and on the label which is fastened to the skull.

2. The locality where a specimen has been taken may be shown in various ways. If the place is well known and to be found on the map, the designation may be by two or three words, as, for example, Hastings, New York. If, however, the locality is at a distance from any well-known spot on the map, a designation as above is hardly sufficient and an explanatory clause should be added, as, for example, Santa Rosa, Chillo Valley, east of Quito, Ecuador, altitude 8000 feet.

3. The date is best written out, May 7, 1925, not 5-7-1925, which might be construed either as the seventh day of the fifth month or the fifth day of the seventh month.

4. The sex is ordinarily determined by inspection of the external sex organs or genitalia and only rarely is it necessary to make an internal dissection to ascertain whether the specimen be male or female. The sex is best indicated on the label by sign, ♂ for male, ♀ for female.

4. The measurements are of considerable importance and should be taken in millimeters whenever possible. The measurements ordinarily taken are the total length, the

length of the tail vertebræ, and the length of the hind foot. European collectors and workers prefer to take the length of the head and body and the length of the tail, arriving at the total length, if they wish it later, by addition. The American method will give the length of head and body, if it is desired, by the process of subtraction.

The total length is the distance in a straight line from the tip of the nose to the tip of the tail, exclusive of the hair. The animal is straightened out so that there are no curves in

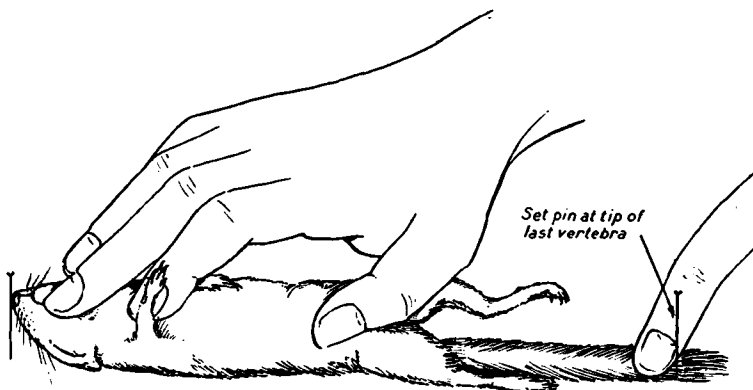


Fig. 4. Showing method of securing total length.

the vertebral column and, if *rigor mortis* has set in and the animal is stiff, the carcass must be stretched and manipulated to bring it into a natural position. Place the specimen on a board or table, as shown in the sketch, and set a pin at the tip of the nose and at the end of the last vertebra of the tail. It is possible to take the total length by holding a small mammal directly on a ruler, with the end of the ruler at the tip of the nose, and locating the tip of the vertebra with the thumb or fingernail, taking a reading from the ruler without recourse to pins. For one who is learning, the measurement will be more accurate if pins are used and the ruler applied to them.

The length of the tail vertebræ is taken as shown, from the base of the tail to the skin of the last vertebra. The tail is bent at right angles to the body to facilitate the taking of this measurement.

The length of the hind foot is taken from the heel to the end of the claw on the longest toe. The toes should be straightened out and the easiest way to keep the foot straight

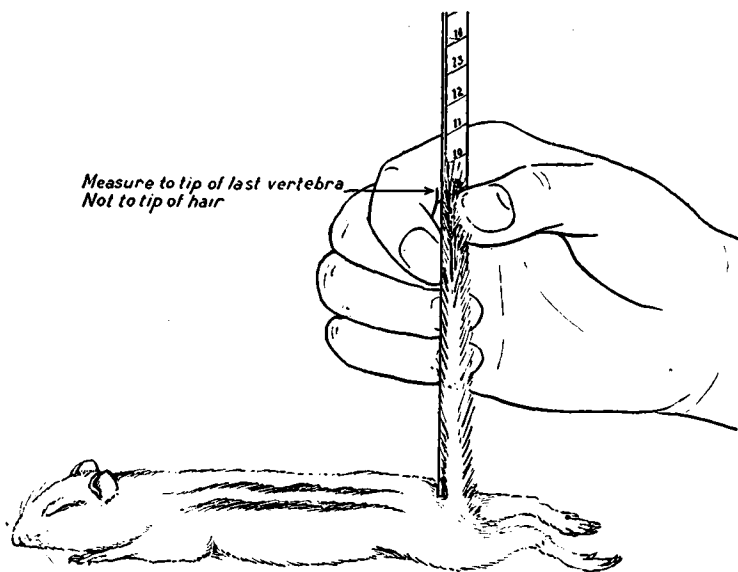


Fig. 5. Method of taking length of tail vertebræ.

is to press it against the flat side of the ruler, as in the figure. This way of taking the hind foot measurement to include the claw, often written as "length of hind foot, *cum unguis*," or simply "length of hind foot, c.u.," differs from the method employed by Europeans who measure only to the fleshy tip of the longest toe. This measurement without the claw is known as "length of hind foot, *sine unguis*," or "length of hind foot, s.u." Specimens collected for the American Mu-

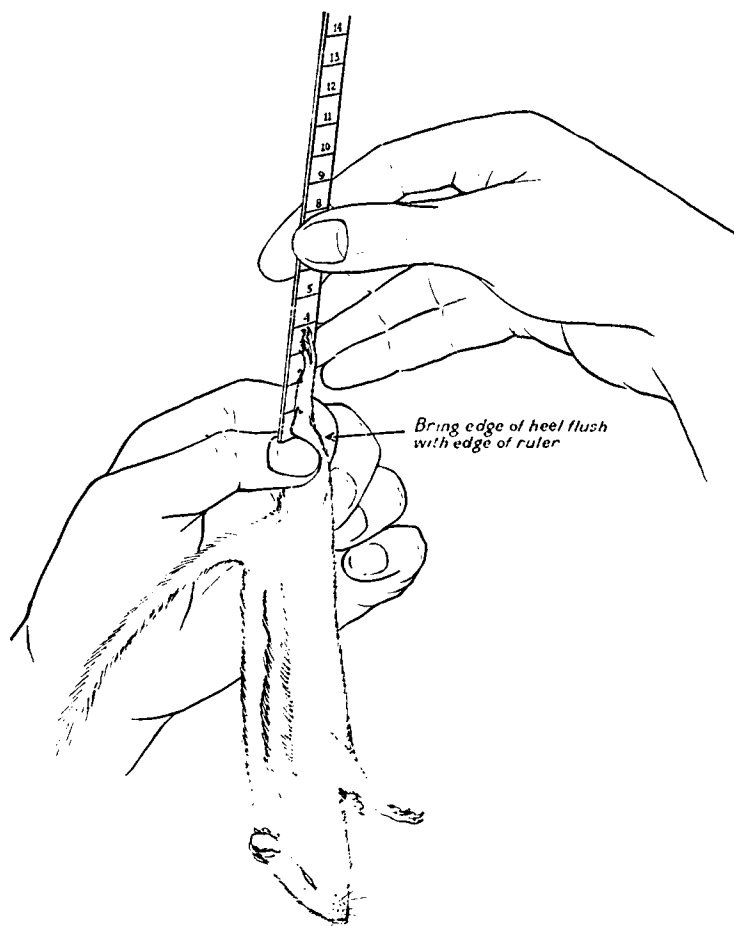


Fig. 6. Method of measuring the length of the hind foot.

seum of Natural History are always measured to include the claw in the length of the hind foot.

Sometimes the height of the ear above the crown of the head affords a valuable measurement. This is written on the label, "height of ear above crown," and may be taken by

placing the end of the ruler on the crown of the head at the base of the ear and then reading to the tip of the ear, exclusive of the hair.

Field Catalogue

It is important to keep a field catalogue of the mammals collected and to record in it all the data that is written on the label and such additional notes as seem worth while (see page 51). This catalogue may be any convenient size. The catalogues used by the American Museum give a line to a specimen, but the line runs across two pages and the data is entered in this order: collector's number, name of mammal (in the field this may be only "rat," "mouse," "squirrel," etc.), sex, locality, date, measurements, remarks. By writing remarks at the right-hand margin of the page there will be ample space, since extensive remarks will not be given for each specimen and if the part of a line regularly allotted to a particular specimen is not adequate, the note can be run over a line or two without crowding the page.

TO SKIN A SMALL MAMMAL

A chipmunk is selected as a typical small mammal, and mammals up to a raccoon in size are skinned in this fashion. The very first things to be done are the taking of measurements, the writing of the label, and the recording of data in the field catalogue.

With the chipmunk laid on its back, part the fur along the mid-line of the abdomen and make the opening cut from

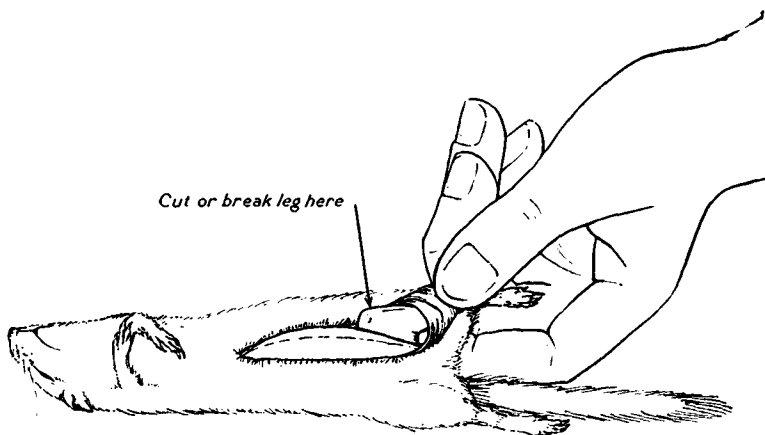


Fig. 7. Showing the opening cut and one leg freed from the skin at the knee

about the breast bone to the base of the tail. Figure 7 shows the extent of this cut, which should be through the skin only and not into the abdominal cavity.

Loosen the skin from the flesh along the sides of the cut, using the fingers or the flat end of the scalpel handle. A pinch of dry cornmeal dropped into the cut will be of considerable help in manipulating the skin.

Keep a container with cornmeal on the skinning table and do not be sparing in its use. Cornmeal not only absorbs the body juices, keeping the fur and skin clean, but the

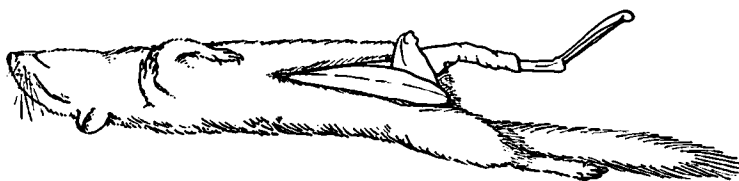


Fig. 8. The leg has been unjointed at the knee and the flesh has been stript from the tibia.

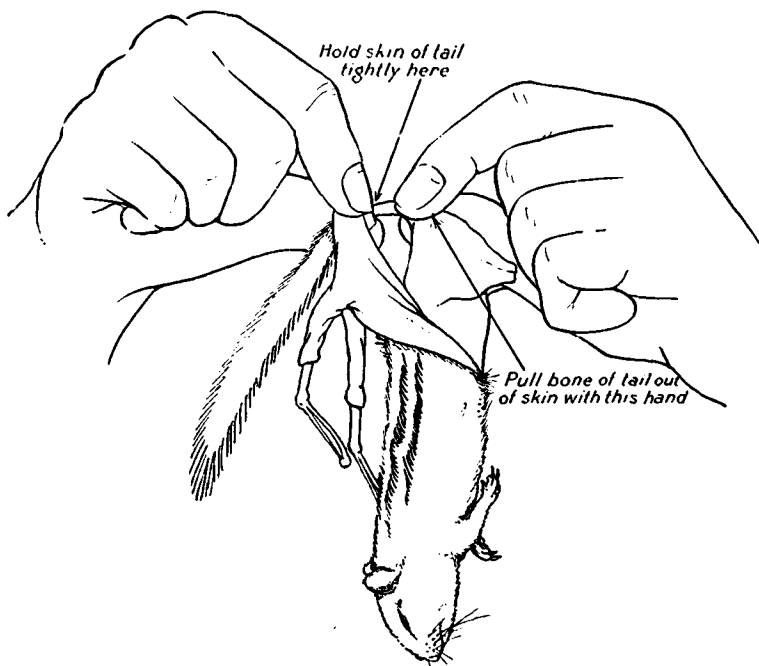


Fig. 9. Removing the tail vertebrae.

presence of the sharp grains on the fleshy side of the skin is a great aid in working and handling an otherwise slippery surface.

Work the skin loose from the knee and upper leg so that the knee-joint may be thrust upward, as in Figure 7, unjoint the leg at the knee and work the skin back as far as it will go. Clean the flesh from the lower part of the leg. See Figure 8.

Skin out the other leg in the same manner.

Cut away with the knife or scissors any tissue at the base of the tail and work the skin of the tail loose until it may be grasped as in Figure 9. The skin may be grasped between thumb and forefinger with the fingernails serving to strip the skin from the bone. Forceps may also be used to do this stripping. A steady pull on the base of the tail should bring the vertebræ out entire. Occasionally a mammal is found, the tail of which must receive special treatment, or a shot may have cut a vertebra. In that event the skin of the tail may be split for a short distance along the under side and sewed up afterward.

With both legs and the tail free, the skin is rolled back until the forelegs are reached. This parting of the skin from the body may be accomplished partly by manipulation with cornmeal and the blunt handle of the scalpel, partly by cutting strands of tissue here and there.

The skin should never be pulled until it stretches, at any stage of the skinning.

The forelegs are worked free of the skin, unjointed at the elbow, and cleaned in much the same manner employed for the hind legs. See Figure 11.

The skin is then rolled back until the bases of the ears are reached. Cut these with the scalpel as close as possible to the skull. Do not cut the bone of the skull, however. See Figure 10.

As the skin is worked over the head, the eyes will be exposed. Cut the eyelids free with the point of the scalpel,

working carefully to avoid cutting the lid. This means that the point of the knife must work deep. Probably the novice will learn just how deep only by passing through the experi-



Fig. 10. Skinning about the ears.

ence of cutting off a few eyelids. The skin is cut free at the nose by slicing through the cartilage; take care not to cut the delicate bones of the nose.

The skin finally parts from the body at the lips and is now turned inside out, as shown in Figure 11. Clean off any bits of fat or meat on the skin. It is especially important that

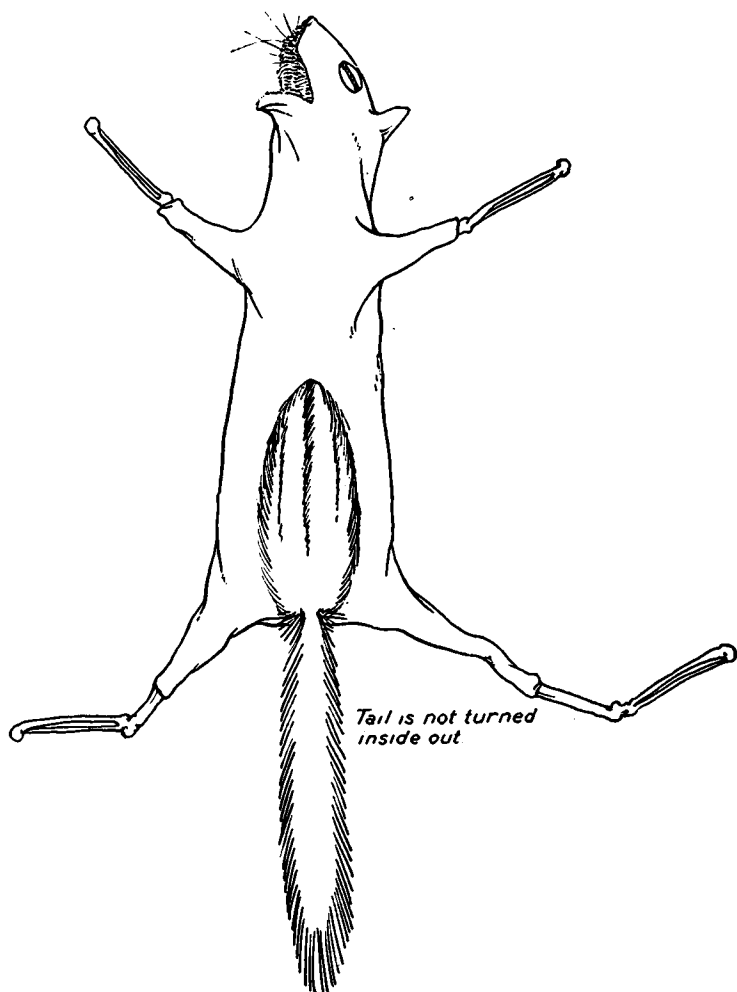


Fig. 11. The skin removed from the body.

all fat be removed from the skin. Take three stitches to close the lips. See Figure 12. Do not take these stitches too deep into the lips.

If the skin is especially greasy or bloody it may now be washed thoroughly inside and out with soap and water or in benzine. Avoid stretching the skin while it is thus wet and lax but otherwise it may be handled like a piece of cloth. Squeeze out the surplus moisture; do not wring out the skin lest it stretch; and dry the fur by a liberal use of dry corn meal or sawdust. As fast as the cornmeal absorbs moisture and becomes damp, replace by fresh, dry cornmeal and very shortly the fur will be dry and fluffy. The skin may then be turned inside out again to be poisoned.

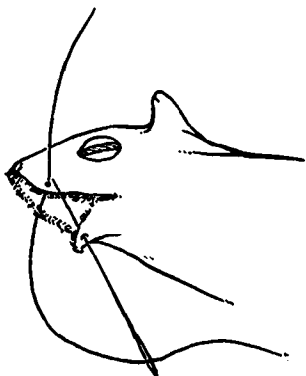


Fig. 12. Stitching the lips.

Now dust over the skin thoroughly with the arsenic and alum mixture, using a small brush, a rabbit's foot, or a tuft of cotton on a stick. See that the powder comes in contact with every part of the flesh surface. Work some of it into the tail, using a wire to dust it down past the base of the tail.

It should be needless to caution the worker that the arsenic mixture is poisonous if taken into the stomach. It is also a powerful irritant if it gets under the fingernails. The use of cornmeal in skinning generally protects the fingers, because the cornmeal gets under the nails first and prevents the accumulation of arsenic there. Do not dip the fingers into the arsenic if it can be avoided.

Shake off any surface arsenic and alum; turn the skin right side out.

If the mammal is of fairly good size, and the climate is

such that skins do not dry quickly, it will be advisable to slit the soles of the feet in order to get arsenic in at the base of the toes and about the phalanges. Perhaps it will be possible to remove some of the fleshy tissue from the soles of the feet through this opening, which can be made either at the extreme edge of the palm or sole, or down its median line. The opening may be closed by a stitch or two after the preservative has been sifted in.

TO FILL OUT THE SKIN OF A SMALL MAMMAL

Prepare a body of tow for the chipmunk, pulling out the fibers until all point the long way of the body. Do not make the body too large: judge the size somewhat by the size of the carcass you have just removed but remember that the tow will compress.

Bend over the tow at the extreme end of the body so that the short ends of the long fibers are directed back along the body and the head end of the tow form is bluntly rounded. Grasp this end with the forceps and insert the tow into the skin, working it into the head and nose, as shown in Figure 13. Fill out the nose and shape the head, drawing the skin of neck and body smoothly over the form. Cut off the tow so that the new body just fits at the base of the tail.

Twist up a wisp of tow over the points of the forceps by twirling the forceps in the tow, slip the tow into the leg between the bone and the skin as far as it will go, grasp the point with the fingers of the free hand and the forceps may be withdrawn, leaving the tow in the leg. The leg should be drawn out straight as this is being done. See Figure 14. One wisp of tow is sufficient for the foreleg but two will make a better hind leg.

The next step is to wire the tail. Straighten out a piece of wire by pulling on it until it gives a trifle. Cut off a length equal to the length of the tail plus the length of the opening cut in the skin. The size of the wire should be such that it will go to the end of the tail and yet be stiff enough that it will not bend easily. In the case of species where the tail is long and tapers to a fine point, it may be necessary to dress down the terminal inch or two of wire with a file.

Twist a little cotton or tow tightly about the wire to fill out the tail. At first it may prove difficult to get a thin, even layer of cotton on the wire; the knack comes with practice and consists principally in adding the cotton, a thin wisp at a

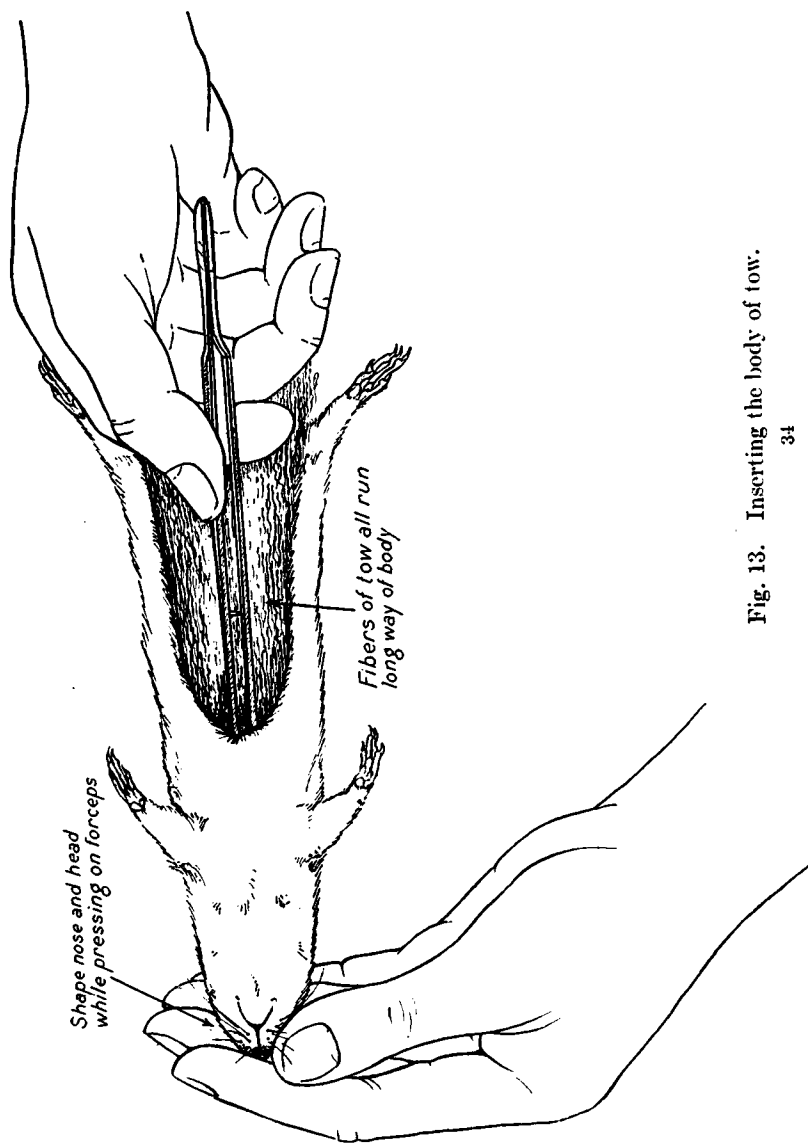


Fig. 13. Inserting the body of tow.

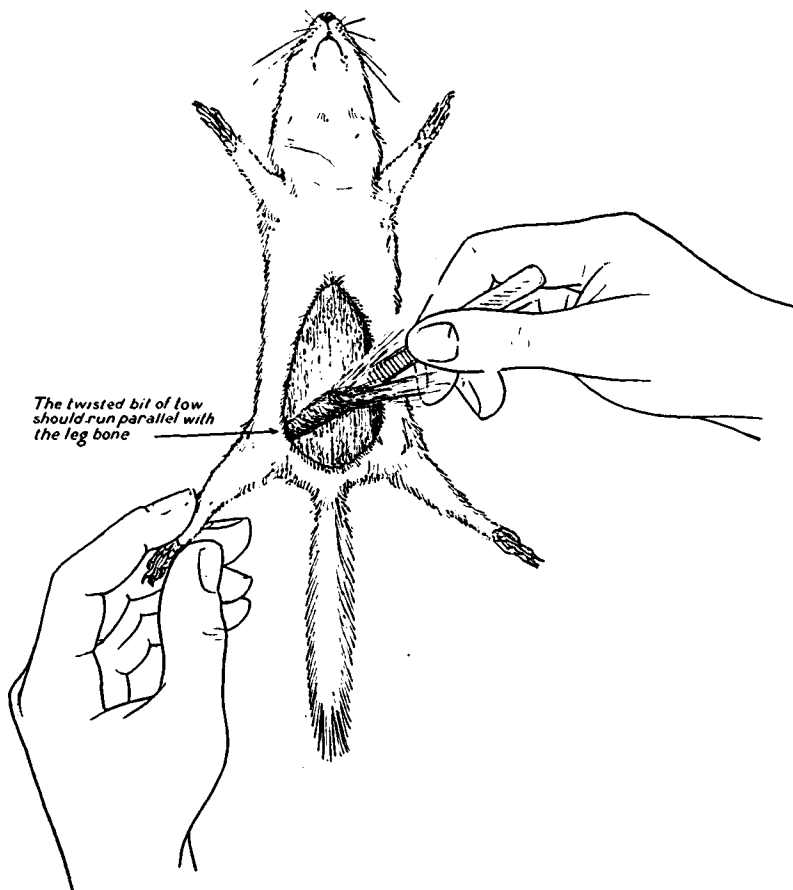


Fig. 14. Filling out the legs with tow.

time, and twirling the wire to make it lie flat. Be careful to not put on too much or you may push the tail off trying to get the wire in. By carefully working the wire down the tail it will go the full length and the part of the wire outside will slip into the cut along the abdomen. See Figure 15.

Lay the chipmunk on its belly and try a preliminary shap-

ing-up of the skin. See if it will look about as in Figure 17. It may be necessary to slip in a little more tow about the rump.

If the filling seems satisfactory the skin is then sewed up as in Figure 16. The thread will hold best if it is tied into

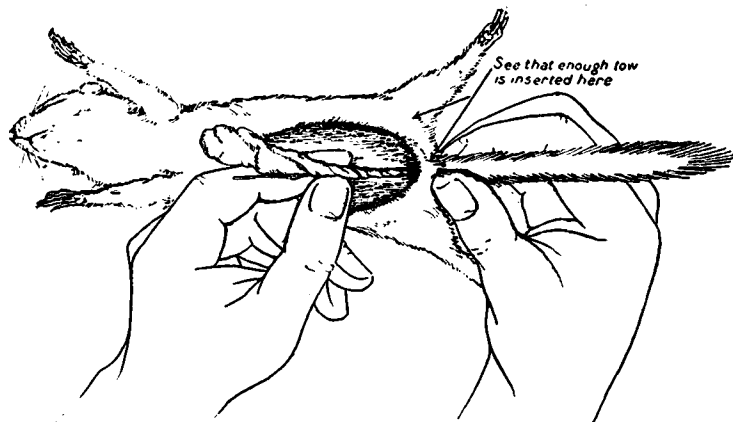


Fig. 15 Filling the tail with a covered wire

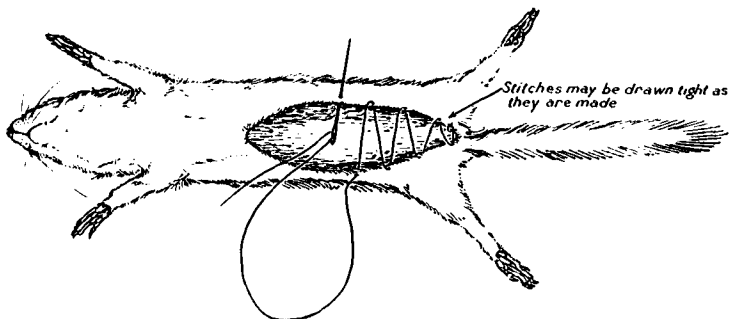


Fig. 16. Sewing up the skin.

the skin at the base of the tail. A knot at the end of the thread often pulls through. The thread should be caught with a single loop-knot where the sewing finishes off.

Take the tooth-brush and brush off any blood or dirt on the finished skin.

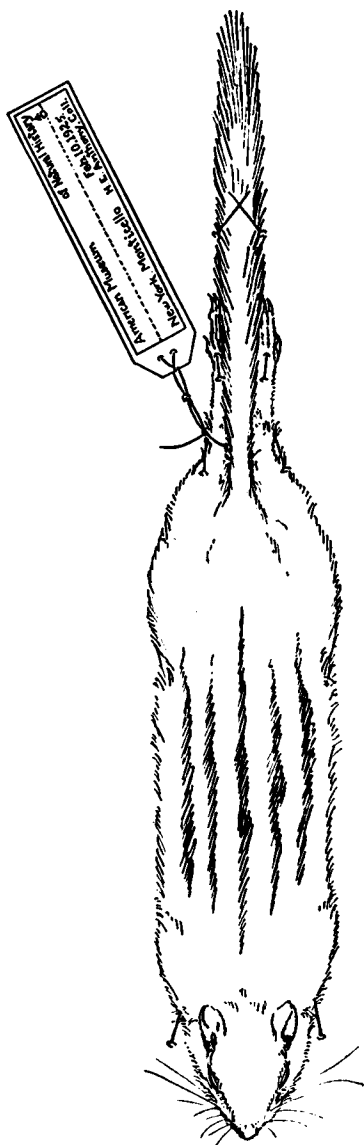


Fig. 17. The finished skin, pinned out.

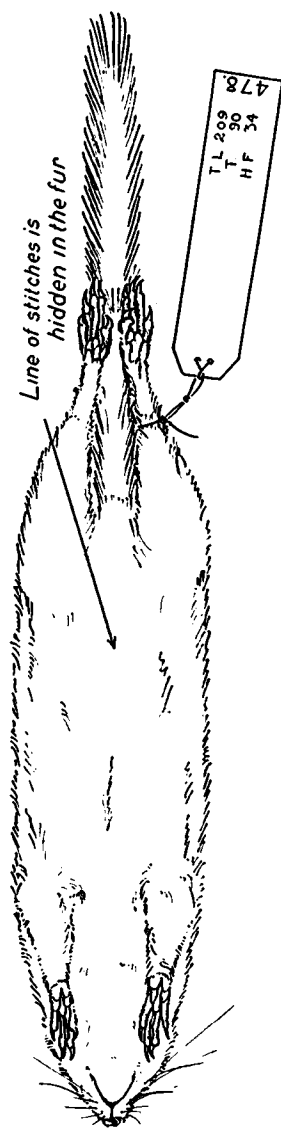


Fig. 18. The finished skin, from the underside.

Tie the label, with the complete data, on the right hind leg, making a secure knot just above the heel so that the thread can not slip off.

Pin out the skin on a board, running the legs close to and parallel with the body and arranged as shown in Figures 17 and 18. The position of the pins may be seen in the figures, one in each hand and foot, one at the side of each hind leg to keep the feet in close, and two pins crossed over the tail.



Fig. 19. A skull properly labelled.

Remove the skull from the carcass by unjointing carefully at the neck. Cut off from the skull only the largest of the muscle masses in the case of medium-sized species but remove nothing from skulls of the small species. A certain amount of tissue dried onto the skull will protect it until it can be properly cleaned.

Remove part of the brain with a wire, but it is not advisable to clean out delicate skulls too thoroughly in the field if they may be adequately dried. The thin vault of the cranium is very apt to be crushed unless special provision is made for its protection.

Remove the tongue and fasten on a skull label which has the same number on it as is on the skin. It is well for the collector to add his initials to the label also. If paper labels are used the number should be on each side of the label. No tragedy in a collector's experience is keener than the inability to match skulls with skins after they have been brought in from the field.

Do not allow skull labels to become stained with blood. Dip skulls into cornmeal; it hastens the drying and keeps the labels from adhering to the flesh. Do not dip the skulls into the arsenic-alum mixture. Do not allow blow-flies to have their own way with your skulls. The skulls may be kept on a wire and hung up out of the way of dogs or animals

to dry. Run the wire through the loop of wire or string on the label, not through any part of the skull. Skulls may also be dried out in a small box, one or more sides of which are screened. Above all, do not allow your skulls to get wet and remain wet; they macerate or decay when wet and the resultant discolored mass may be of little use to any one, if the decomposition goes so far that the jaws drop away from the skulls and the numbers cannot be associated with the skulls.

Very satisfactory skull labels may be made from strips of block tin or monel-metal; the number may be stamped on or scratched on with a sharp tool, and if the monel-metal wire is used to fasten the label to the skull, there is little chance for the label to become illegible or to drop off.

Small skins will require about a week or ten days to dry out under normal conditions. Keep them out of the direct sunshine, but where there is a good circulation of air. In the tropics it may be necessary to dry the skins by artificial heat. If this is done, keep the specimens as far from the fire as is possible and still dry them. Too much heat will hurt them and the smoke will stain them. When thoroughly dry they may be removed from the boards, wrapped in paper, and carefully packed in some suitable container.

Collecting Chest

Sketches are shown of the type of collecting chest which I have found most useful. A regulation army locker-trunk is the foundation. This trunk comes equipped with a tray (Figure 20) which lifts out and generally rests across two transverse cleats at the ends of the trunk.

Remove these transverse cleats and fit four upright cleats at the corners, as shown in Figure 21. These cleats should be high enough to support the large tray where it belongs, at the top of the trunk. The cleats should be about five-eighths or

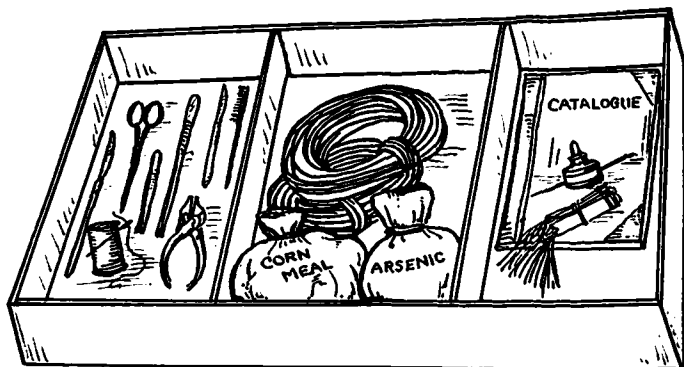


Fig. 20. The tray which rests in the top of the collecting chest.

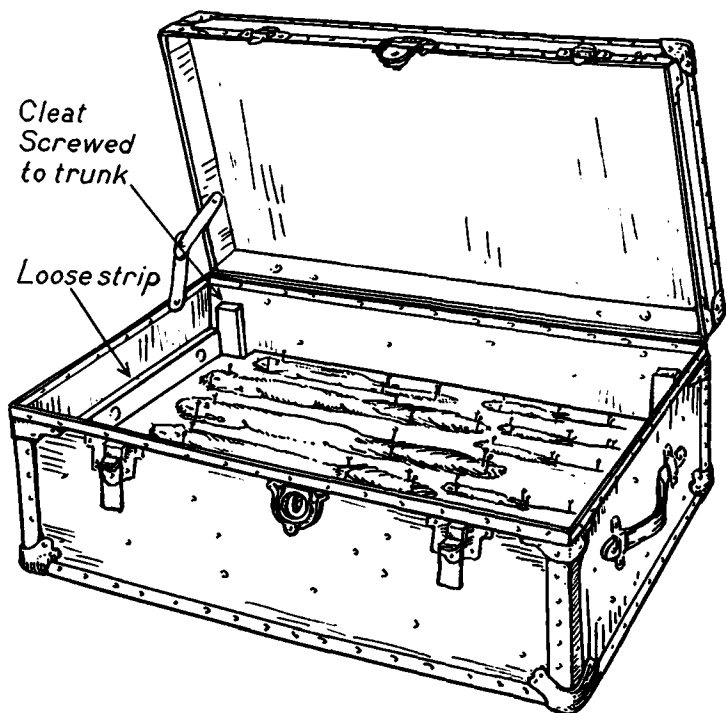


Fig. 21. A convenient collecting chest.

three-quarters of an inch in from the ends of the trunk to allow narrow strips to pass between them and the ends.

Five or six boards of thin material—I have found “compo-board” most satisfactory—are cut as shown in Figure 22 so that they will just drop easily to the bottom of the trunk. Two strips, the width of the board, are cut for each board but are not fastened to the board in any way. The width of these strips will govern the depth of the tray desired and should be

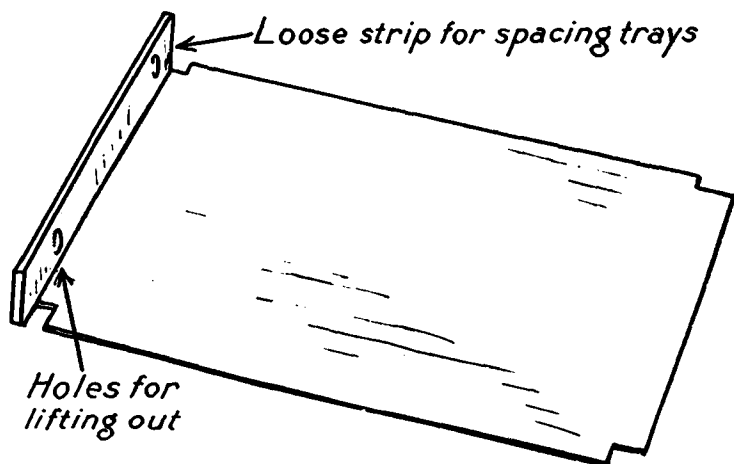


Fig. 22. A drying board with one of its two spacing cleats.

so figured that when the requisite number of boards and strips are assembled, as shown by Figure 21, the last board comes up to the level of the large tray. A useful width of strip will be one and a half inches for the average small mammal, but some may be only one inch and at least one pair will need to be three or three and a half inches wide.

The method of using these boards and strips should be obvious from the figures. The boards, when not in use, lie flat in the trunk and leave most of the trunk space available for packing. When skins are pinned out on the boards, the

boards are spaced one from another by dropping strips across the end. Holes at the ends of the strips allow the fingers to be inserted to lift the strips out.

If the skins are securely pinned into the soft wood, they will not shift during transportation. Skins should be pinned rather closer to one another than is shown in Figure 21. In placing mammals, allow for the space taken up at the end by the strip which will be inserted later. A thin layer of cotton laid upon the skins will make them still more secure when pressed down by the board of the succeeding tray.

Handy containers for dried skins are made by cardboard suit boxes. These are obtainable in flat, unassembled shape, and fit into the bottom of a locker trunk after they have been bent over at the side or end. This bending is along a line later used for the assembled box, so that no harm is done. The suit boxes filled with dry skins are later packed in whatever containers are available for shipment, and, because they may be securely packed as units, the skins come through in better shape than if they were packed directly into the large container.

When dried skins are permanently packed up they should be laid out flat and close to one another, so they can not shift about. Each skin should be wrapped carefully in a piece of paper before it is finally packed. It is advisable to separate each layer of skins by a thin sheet of cotton and to fill in any cavities with wads of cotton or tow. If the layers are very uneven, a sheet of cardboard might be employed to even up the pressure on the skins. Scatter naphthalene flakes in among the skins as they are packed.

Do not pack skulls with the skins if it is reasonably possible to avoid it. Insect life that has been feeding on the skulls may attack the skins. If skulls must be packed with skins, kill any insect life in the skulls by dipping them in a solution of arsenic and water, in weak alcohol, or even in weak formaldehyde. A short immersion kills all insects and does

not injure the skulls. Needless to say the skulls are thoroughly dried again before packing.

THE PRESERVATION OF SMALL MAMMALS ENTIRE

It is often well worth while to save entire specimens of small mammals for future dissection and anatomical study at the museum.

For this purpose either alcohol or formaldehyde may be used. For strength of solution, see page 11.

The specimen is opened up along the belly, the cut penetrating into the abdominal cavity so the solution may reach the viscera. Take care that the knife does not cut any of the organs. For bats and other small mammals this cut is the only preparation required and they may be dropped into the jar or can of preservative solution. Labels with full data should be tied to each specimen, of course.

In the case of larger species, it may be necessary to inject some of the solution into the mammal because immersion alone will not be sufficient. A large, injecting, hypodermic needle must be carried for this purpose. When the animal is of such a size that the body fluids may so dilute the preserving solution that decomposition sets in, the weakened solution must be replaced by fresh liquid at the end of several days.

When many small specimens are placed in one container they should be wrapped individually in a little cheese-cloth or muslin; otherwise rubbing may take the hair off.

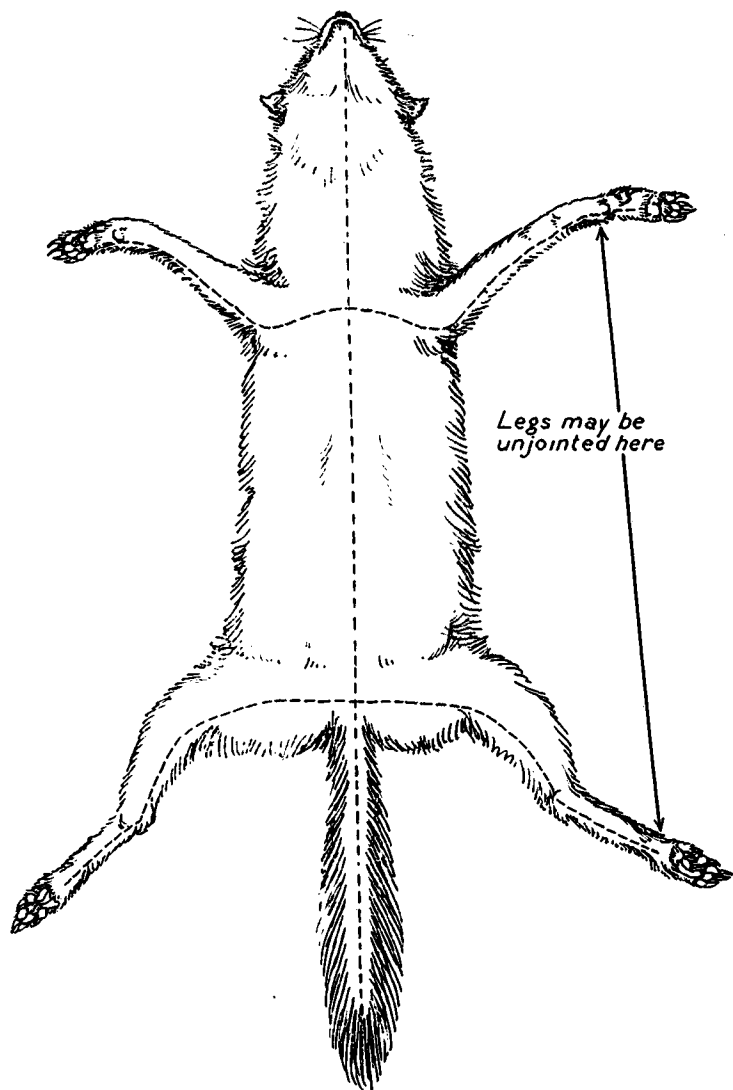


Fig. 23. Opening cuts for larger mammals.

TO SKIN A LARGE MAMMAL

If packing space is limited it may be advisable to fill out in the field nothing larger than a small squirrel. The skinning of these smaller mammals which are to be stuffed later is best done as described for the chipmunk.

Mammals larger than woodchuck, opossum or raccoon are seldom stuffed in the field. They are skinned in somewhat a different manner than that described for the chipmunk; the skin is poisoned and dried flat and is made up later at the museum.

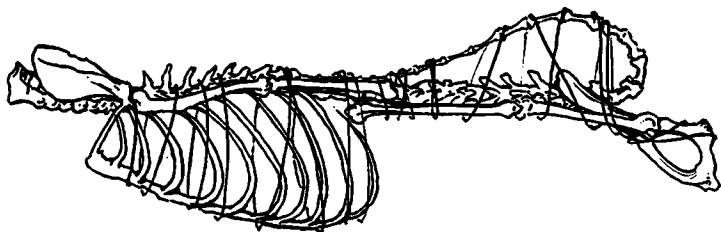


Fig. 24. Skeleton tied up for packing. This skeleton is rather better cleansed than will be necessary for the smaller mammals and a thin layer of flesh and muscles should be left to dry over the ribs and the processes of the vertebrae.

Measurements are taken as for the chipmunk. The opening cuts are shown in Figure 23. The skin is thoroughly poisoned and dried out over a cord or rope. Care should be taken that the skin does not wrinkle so that folds are closed off from the drying influence of the air. The dried skin is rolled up in a compact bundle.

Instructions for preparing the largest mammals, and the procedure to be followed in securing material to be mounted, are given in a separate publication.

Skeletons

The collecting of material for skeletons is also given in a separate publication by the American Museum of Natural History entitled, "The Preparation of Rough Skeletons," by Dr. Frederic A. Lucas. See Figure 24, showing a small skeleton prepared in the field.

In the case of very rare specimens it is often desirable to make as complete a skin as possible and to save as much of the skeleton as remains in the carcass. In this case the skin is taken off as usual, care is exercised to unjoint rather than break the limb bones, and the skeleton is prepared as described in the handbook just listed.

SAVING ODD MAMMAL SKULLS

In the majority of cases the skull is fully as valuable as the skin, and often constitutes the more valuable part of the specimen. For this reason the collector should save odd skulls without skins. For example, a specimen may be secured in such condition that the skin is valueless and the skeleton as a whole badly broken. The skull of such a specimen might show all of the essential characters of the species and be well worth saving. Odd skulls should have a record made in the field catalogue, and preferably on the skull label as well, that the specimen is "skull only." This saves trouble later on when one looks for a skin to match.

A valuable source of odd skulls is owl pellets. Many of the owls live largely on small mammals and, in the regurgitated pellets of these birds may be found skulls of practically all of the small mammal fauna of the region. From an inspection of these pellets, the collector can get a very good idea as to what he may trap for. The owl is a better collector than man can hope to be, and not a few species new to science have been based upon odd skulls obtained from owl pellets. Save all skulls found thus; they are valuable.

A good place to look for these pellets is near the entrance to caves, at the bottom of hollows in dead trees, or sometimes under limbs or cliffs where the owls have a habit of perching.

Collecting Bats

The collecting of bats presents problems quite different from those encountered in the pursuit of flightless mammals. Not only are bats difficult to secure, but they are also more troublesome for the novice to prepare as skins. Bats are exceedingly important, however, and offer more possibilities to the collector, probably, than any other order of mammals.

Only rarely may bats be trapped. Some of the fruit-eating species may be caught in traps set about ripe bananas, plan-

tains and other tropical fruits, but most of the specimens the collector secures must be shot while flying, or knocked down by sticks. Because bats ordinarily do not take wing until dusk, some of them much later, shooting must be done in uncertain light and with the added disadvantage that specimens actually hit are lost as they tumble out of the sky-line. The flight of bats is so irregular and erratic that they are extremely difficult targets and the collector must be a very good shot to get many with the gun. The best size of shot for shooting bats is No. 12, or No. 10 if they are flying high; and both the small auxiliary charge and the full size 16-gauge shell will be useful.

When bats are found in caves they are much more easily secured. Here a shot may be fired into a colony of them as they are at rest, and often one shell brings down all the specimens required. Perhaps the passages in a cave are low and will allow a collector to reach bats with sticks or switches, and specimens may be knocked down. Bats have the habit, often, of segregating themselves in caves by sex and species. That is to say, all the individuals of a cluster or colony will be one species and one sex. This means that a few specimens should be taken in each part of a large cave in order to be sure that a complete representation has been secured. After a shot or two has been fired in a cave the bats may take wing, and such a state of confusion reigns that the collector will have no way of telling what he is collecting until the specimen is in his hand.

A net may be stretched across the entrance to a cave and the bats driven out into it. Mosquito-bar or cheese-cloth may be used for this purpose. An insect-collecting net or butterfly-net occasionally comes in handy in cave collecting.

Some species like to fly back and forth over the water and are thus more easily found when shot because they fall into the water. If the water is still or slow-moving, and one is able to retrieve what he shoots, such a collecting site will

prove very valuable. Little clearings in the forest or open meadows will also be good places to watch for bats.

Bats may frequent dwellings or old buildings and are secured by much the same methods as are employed in caves, namely, shooting, knocking down by switches, or netting. Hollow trees in the forest may be the home of desirable species which can be smoked out by a fire and shot or netted as they emerge.

Some of the rarest species of bats are forest dwellers and spend the day hanging in thick clusters of leaves or where two or three leaves hang together to make a shady nook. Such dark spots are made when a banana or plantain leaf is broken across the mid-rib by the wind and hangs down, in shape like an inverted V. At the apex of the V there may be a bat or two and a shot may be fired at a venture with a fair chance of specimens, if the collector is in a good bat country.

Bats are skinned just as the chipmunk was skinned, page 26, but may be more troublesome at first because of their somewhat different body shape and the presence of wings. Be sure to break the wing at the humerus so that the elbow joint is left in the specimen, and when making up the skin remember to leave the elbow in a position to afford the measurement of the forearm, to be taken from the dried skin later.

No difficulties will be encountered in stuffing the skins of bats, but the collector may be troubled when he attempts to pin the specimens out to dry. Pin the bat out with the back up, belly to the board, just as with the chipmunk. Set the wings close to the body by a pin through the wrist, drawing the wrist close up to the neck and body. Bring the thumb with its sharp, tiny claw, back against the wing, so that it does not stick out to catch on things. The long finger joints or phalanges will tend to arrange themselves in a natural order, running backward from the wrist close together and parallel. A pin or two at the tips of the wings helps to hold the wings in place.

The hind legs are generally pinned farther apart than would

be the legs of a rodent, for example. This is to allow for a better display and arrangement of the interfemoral membrane which extends from leg to leg and may include the tail.

Instructions are given elsewhere for preserving bats as alcoholic specimens.

Miscellaneous Hints

After one has prepared a few small mammals, various short cuts in procedure may suggest themselves. Individual deviations from the practice described in this handbook may be worked out without detracting in any way from the satisfactory nature of the final result.

I find it easier to break the legs of small mammals with my fingers, thrust the broken end of the limb bone through the flesh, and strip the meat off, rather than to unjoint the legs.

Short wires may be cut for the legs. These wires are twisted into the filling for the leg, thrust into place and left there. This makes a very strong leg and is excellent practice.

In making up skins of rabbits and hares it will be necessary to use a long wire running from the toes of the forefoot to the toes of the hind foot. The skin of these animals is so delicate that the legs will break off unless such a wire is used. If one end of the wire is sharpened, it may be thrust clear through the forefoot far enough to allow the other end to be inserted into the hind leg.

It may be more convenient to remove the skin and clean the meat from the legs as a final process, cutting the legs free from the body with scissors at the moment of skinning.

If pressed for time, with many specimens to save, I often skin everything before beginning to stuff the specimens. This practice may save mammals on the verge of decomposition. The poisoned skins turned right side out are kept in a box or placed where they can not dry out too fast before they are stuffed.

The tails of some species will not strip readily from the vertebræ and must be split along the underside their entire length. This is true of the skunk and the porcupine.

MISCELLANEOUS DATA FOR LABELS OR NOTEBOOKS

All data of a nature not already well known, such as notes on food, life-histories, or details of soft structures which are not discernible in a dried skin, should be set down on the label, or in the field note-book if too voluminous for the small space available on the label. Facts that are known to be well established do not call for special notes, but it is well worth while to have some sort of record of even seemingly trivial data because we know so little of the life-histories of most of our small mammals.

Unless one is a specialist in such matters, it is difficult to identify stomach contents of small mammals while in the field. A specimen or two in alcohol, or simply the stomachs themselves in preserving fluid, may be saved for a later examination in the laboratory. However, it is often possible to discover what the mammals have been feeding on by an examination of food in mouth or cheek-pouches before it has been chewed into fine particles. Perhaps the food of a species can be discovered in its runways or burrows.

The condition of the sexual organs is worth noting, as this has a bearing on the breeding season. The number and stage of development of any foetuses found should be noted on the label. If the mammary glands of a female show the animal is nursing, record it so on the back of the label.

Often the arrangement and number of the pads on the feet are different in closely allied forms, and it is of importance to know the condition of the plantar and palmar surfaces. In a dried specimen it may be impossible to make out from the shrunken foot whether the mammal had five or six plantar pads, for example. This is readily apparent if the animal is examined in the flesh and should be noted on the label if the specimen is suspected to be a rare or unknown species.

Many of the external characters of bats are either lost or so distorted in a dried specimen as to be of little value. Struc-

tures on the nose and ear especially should be examined and any peculiarities noted on the label or in the note-book. So important are these structures in identifying bats that it is highly desirable to save some of each species in alcohol or formaldehyde. A good rule is to save the first specimen of each distinct bat collected, as an alcoholic. Then if no more are secured the maximum amount of data can be obtained from the one specimen.

GUARDING AGAINST ANTS

Often in the tropics ants will prove decidedly troublesome and no very satisfactory methods have been evolved to escape them. Skins may be protected by naphthalene, paradichlorobenzene, or insect-powder, as has already been pointed out, but there is no way to keep ants from attacking the bait in the traps or the specimens caught by the traps.

Any substance placed upon the bait to render it unattractive to ants has an undesirable effect upon the appetites of the mammals one wishes to catch. If a trap-line can be run only once a day the ants may carry off all the bait before a mammal has the opportunity to visit the trap. If it is possible to rebait the traps late in the afternoon it is well worth while to do so.

The greatest damage done by the ants is upon the trapped mammal, which is sometimes injured beyond all hopes by the time the traps may be run in the morning. If the collector can visit part or all of his trap-lines about 9 or 10 o'clock in the evening, he can prevent the ravages of the ants from assuming such disastrous proportions. If the mammals could be trapped alive probably many of them would be able to fight the ants off, but it should be remembered that ants have been already attracted to the spot by the bait and are apt to devour a small creature in confinement. In any event, it is out of the question for the collector who is working

in out-of-the-way places to carry an extensive line of the bulky live-traps.

When doing the first collecting in a locality it is important to save the first specimen of each species taken, regardless of its condition. It may be the only one taken during the entire stay. Later, when damaged specimens of a species demonstrated to be common are taken, they may be discarded or made into skeletons. If the ants have attacked only the soft parts the specimen may still be perfectly satisfactory as a skeleton. It may be best to preserve an ant-damaged specimen in formaldehyde or alcohol, if a series of holes have been eaten in the skin.

A more extensive account of some of the points taken up in this handbook is given in "The Art of Taxidermy" by John Rowley, published by Appleton & Co., of New York City. A more recent and enlarged edition of this work is now on the press and will be published shortly. These books by Mr. Rowley are recommended without reservation.

MATERIAL TO BE SENT TO THE AMERICAN MUSEUM

Mammal skins to be sent to the American Museum should be well dried, carefully packed in strong, tight boxes, with some substance like naphthalene to keep insects out, and shipped in such a manner that the specimens can not be damaged by heat or water. Sometimes boxes may be packed near to boilers on the steamer or left out on the deck. Either practice will be injurious to skins. Address the box plainly to

American Museum of Natural History,
New York City,
U. S. A.

Any questions of customs duties or entry into the United States will be taken up and arranged for by the American Museum.



00038555

